

LANDSAT COMMERCIALIZATION

HEARING

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

AND THE

SUBCOMMITTEE ON
SPACE SCIENCE AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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LANDSAT COMMERCIALIZATION

THURSDAY, JUNE 13, 1985

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND
TECHNOLOGY, SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT, AND SUB-
COMMITTEE ON SPACE SCIENCE AND APPLICATIONS,

Washington, DC.

The subcommittees met, pursuant to notice, at 2:10 p.m., in room 2310. Hon. Jim Scheuer and Hon. Bill Nelson (chairman of the subcommittees) presiding.

Present: Representatives Scheuer, Nelson, Brown, McCurdy, Andrews, Mineta, Walker, Lujan, Smith, and Schneider.

Mr. SCHEUER. The subcommittees will come to order. It's with great pleasure that Chairman Bill Nelson and I have convened today's hearing on Landsat Commercialization.

Many of the members here today, and our distinguished witnesses, have spent many, many hours in bringing us to where we are today; namely to the birth, and at the threshold, of an entirely new U.S. high-tech industry, an industry in remote sensing.

Dr. Calio, in the testimony that he gave—that he will give—in a few minutes, lays out in some detail the twists and the turns and the tangles that the Landsat commercialization process has followed over the last few months and years. I can add little to what he is about to tell us, except to say that over the past couple of years, this process has typified, has been marked, by an unusual degree of cooperation between industry, the Congress, and the administration. And, of course, this cooperation was indeed the key to the enactment last July of the Land Remote Sensing Commercialization Act of 1984, which has guided the commercialization process.

In response to that legislation, the Secretary of Commerce has selected the Earth Observation Satellite Corp., here and after known as Eosat, as the entity which will spearhead the U.S. land remote-sensing industry for the next decade.

Three weeks ago OMB director, David Stockman, after a bit of gentle prodding, sent an \$125 million funding request to the Congress to permit the phased transfer of land remote sensing to Eosat. So, it's in the light of this funding request that we have convened this hearing.

Now, it's our intent today to examine three relevant issues. First, does the contract, the proposed contract, between Eosat and the Department of Commerce, faithfully follow the letter and the spirit of the enabling legislation? That is, does the contract follow the

congressional intent regarding national security, international relations, and U.S. technological leadership?

Second, is the contract, to put it very simply, a good deal for the American taxpayer? And third, what level of authorization should this committee provide for the current and subsequent fiscal years in order to enable Eosat to launch their new enterprise most expeditiously?

In this regard I should note parenthetically that just this morning the Senate Commerce Committee authorized \$295 million for Landsat commercialization through fiscal year 1989. So, that more or less finishes the role for those of us on this side of the dais. Of course we can't kid ourselves—for Eosat, the issue has just been joined.

Eosat faces a very tough challenge in its attempt to create a second major private space industry. They face some very tough international competition from the French and the Japanese, and that will challenge their industry and their technological capability in every direction.

But this, after all, is a technology that was developed in this country, the United States of America. And Eosat is poised both to improve that technology and to launch an aggressive marketing campaign. And I think we're all confident up here that with their efforts, land remote sensing, which is today a by and large underappreciated and underutilized art, will soon begin to realize its extraordinary potential.

Now, I'd like to recognize Congressman Bill Nelson, chairman of the Subcommittee on Space Science and Applications, who has shown such diligence and such imaginative leadership on this whole issue from the very beginning days. Bill.

Mr. NELSON. Well, I want to thank Chairman Scheuer for your particular statement, because you have succinctly laid out the basic issues. There is a fantastic potential offered by remote sensing from space. There's potential for mineral exploration, construction planning, crop surveying, and for some parts of the world, even basic mapping. The list goes on and on.

Rad and I were just out to the Goddard Space Center Monday. And I shared with our colleague, Don Bonker, from the State of Washington, in whose district Mount St. Helen's is, and we are having sent to him a Landsat picture of Mount St. Helen's with a lot of computer overlay, of which they have come up with a picture that, on an hour-by-hour, day-by-day basis, they can continue to track where and how Mount St. Helen's is changing. That's just one application of this fantastic technology.

Jim, you know the interest of my wife in the famine in Africa. And indeed, after Grace held a starving child in her arms last summer it's changed her life. And so, she went out and raised the money, and we chartered a stretch DC-8, and we filled it with 40 tons of food, and flew it over there, and distributed it into the feeding centers last January.

It is absolutely fascinating when you see the Landsat pictures of Africa today as compared to last year, and the year before, and the year before that, and you can see the increasing desert—they call it desertification of that continent.

Now, this is the kind of technology—

Mr. SCHEUER. If the gentleman will yield.

Mr. NELSON. Certainly.

Mr. SCHEUER. I think Ed Muskie, Senator Muskie, originated that phrase that describes how arable land goes into a state of absolute barren desert. And he tells us that there's an amount of land that's turning from arable into desert each year, curiously enough, equal to the size of the State of Maine.

I yield back.

Mr. NELSON. Well, that is part of this technology now. But there's part of this technology that we haven't used. For example, we have not used space remote sensing data to help control human disease. For instance, disease that might spread through irrigation ditches that we could remotely sense from space.

And so, while we are aware and have been talking here of this great potential of land remote sensing, you're also——

Mr. SCHEUER. Blight.

Mr. NELSON. And Jim has just pointed out plant disease. That's something that we can determine from a low Earth orbit. Now, our hope is that we'll be able to achieve more beneficial use of land remote sensing data through this commercial operation.

We want to use the profit incentive to stimulate both wider distribution of the data and the generation of new applications for the data. New applications are going to mean new markets and new benefits.

The legislation that we passed last year strikes a balance between the marketing drive of a commercial operation and the need to preserve the public good in the aspects of remote sensing. The legislation that we passed last year puts into law the "open skies" concept, and the very important concept of nondiscriminatory data access. Open skies is the principle that we have the right to do remote sensing from space anywhere on the globe.

Nondiscriminatory data access means that the data must be made available to all users and potential users on the same basis. And this will prevent the commercial operator from engaging in abusive monopolistic practices.

We had testimony that nondiscriminatory data access will not foreclose significant commercial opportunities. And this is because the highly proprietary and commercially valuable aspect is not the raw data, which must be sold without discrimination, but rather is the information products that can be made from the data. Such products are not covered by that legislation that we passed last year.

So, today's hearing marks the beginning of a new space industry. We're happy to be present, and I am certainly privileged to be a part of that beginning. Thank you for this opportunity, Mr. Chairman.

Mr. SCHEUER. Well, thank you, Bill. You're not only a part of that beginning, but you played a very significant leadership role. Congressman Bob Walker of Pennsylvania.

Mr. WALKER. Thank you, Mr. Chairman. Mr. Chairman, I believe today marks an historic occasion. A contract between NOAA and Eosat represents the first major commercialization of a Government developed system.

This committee has long advocated a policy of aggressive commercialization of space activities. The transfer of Landsat to the private sector is a major step toward implementing that policy.

Earlier this week Chairman Nelson and I visited the Goddard Space Center, as he was just mentioning a few minutes ago, and there we saw a demonstration, that he largely has outlined there, that gave us the latest techniques for computer processing of Landsat data. I came away from that demonstration, as obviously he did, tremendously impressed.

I want to congratulate both NOAA and Eosat on their efforts and on the resulting contract. Our basic function today is to determine if this contract represents a good deal for the American taxpayer. I must say that it certainly appears to be an excellent deal. Under the contract, the taxpayers will receive two new Landsats and a new ground station for about the cost of one satellite.

My major concern is Eosat is going to be in a very tough marketing position with regard to Landsat data, because of governmental actions over the years that have completely skewed the normal market forces. I believe it will take a major effort to make this project a commercial success.

Of course, I have a great respect for the marketing talents of the companies involved, and I have long suspected that one of the major reasons that the Government agencies do not do a very good job of commercialization is that they don't have a single salesman on commission.

Like every member of this committee, I want to see Eosat succeed. We suspect that they will find a number of areas where there will have to be some changes made. One of the great inabilities of Government to market products well is that most bureaucrats are far more interested in form over substance and there is no profit motive.

It is one example of the problem. It occurred right in the Landsat Program. The cost to the Government to process a Landsat frame was \$3,200, and that was the price that we sold a full frame to the user for. He could also buy a quarter frame for \$1,200. However, there was a small problem; the computer could not process a quarter frame. And thus, we have to spend \$3,200 to process the full frame in order to sell the user his quarter frame for \$1,200.

Now, you don't have to be an economist to understand that if you lose \$2,000 on each quarter frame, the more you sell and the faster you sell, the behinder you get. And I would like, as one of the explanations today from Tony, if he could, to tell us how that pricing policy got to be adopted. And even though I understand NOAA recently raised the quarter frame price to \$3,200, I'd also be interested to know how long that policy lasted. But it gives us some idea as to why you've got to have some basic economics in some of the activities of Government that are related to the commercial sector as well.

Mr. Chairman, I do want to join you in welcoming our witnesses here today, and I want to assure them that I hope they will find success in placing Landsat on a solid business footing.

Mr. SCHEUER. Congressman Dave McCurdy.

Mr. McCURDY. Mr. Chairman, I've indicated earlier that I would refrain, but I couldn't pass up the opportunity to mention, though,

that I sure appreciate the comments of the two chairmen and Mr. Walker. I couldn't agree more.

I think sometimes we fail to appreciate the international impact that Landsat has and already has had in other nations. I just recently returned from Argentina, and toured a Landsat facility in Buenos Aires. And the Argentines see Landsat as perhaps the centerpiece of their fledgling space program. They point to that facility with the greatest of national pride.

And at that meeting it was incredible to me that the first questions that they asked, and continually raised during the meeting, was what in the world is the United States going to do with Landsat? Are you going to have a satellite or not? Is there going to be a next generation satellite, because the French are offering their system to us. They've been visited by the West Germans and the Japanese, and they were very much concerned as to the future of Landsat.

So, I just wanted to add those comments before Mr. Calio, Dr. Calio spoke, because I think it's important again that we not just look at the domestic applications within the United States, but that in order to make Eosat commercially viable, that there is an international market that just waits to be developed.

Mr. SCHEUER. Well, I appreciate the gentleman's words. Just to elaborate on what—on the excellent points that Congressman Bill Nelson was making, when he talked about the utility of Landsat in identifying—for mapping purposes, and mapping plant blight, and mapping deforestation, and mapping desertification, all of that material is being made available at a very reasonable rate to developing countries that desperately need it. And that can only redound to the foreign policy interest of our country.

All right, Congresswoman Claudine Schneider.

Mrs. SCHNEIDER. Thank you, Mr. Chairman, and my commendations for calling this joint hearing today on the recent Landsat commercialization activities that we're involved in.

As we all know on our own committee, we've been attempting to look at the goal of maintaining our world leadership in the area of land remote sensing technology. And we spent a great deal of time last year in fashioning the Land Remote Sensing Commercialization Act of 1984, which did establish a very responsible program to transfer our land remote sensing activity to the private sector.

However, there is strong doubt that the private sector alone could currently develop a land remote sensing system because of the high risk and the capital expenditures that are involved.

It's been encouraging to learn that recently OMB has decided to move forward with the budget request for this program; \$75 million, to be exact, has been requested in the 1985 supplemental package, and an additional \$50 million will be requested for 1986. This funding is required as part of the Government's share in carrying out this proposed transfer activity. And I support this proposed request because of the great promise that land remote sensing technology shows, as we've already been discussing here, in a whole broad spectrum of ways; everything from forestry and agricultural applications, weather monitoring, to fire detection in the Midwest, deforestation, and demographic studies, just to name a few.

However, as with all proposed Federal expenditures, I am extremely interested in insuring that our Federal taxpayer's monies are used in the most prudent manner possible. And today we are faced with the review of a proposed Federal program that will amount to as much as \$295 million. So, I look forward to the careful reviewing of the nature of this contract, if there are any potential contract overruns that we're looking at, the number of new satellites that will be built under the contract, the different programs and plans for marketing the data that is generated by the remote sensing system, and I am quite assured that Mr. Calio will be able to answer all of those questions.

I welcome him and the other witnesses, and I look forward to a very productive hearing. Thank you, Mr. Chairman.

Mr. SCHEUER. Congressman George Brown.

Mr. BROWN. Pass.

Mr. SCHEUER. All right. Congressman Bob Smith.

Mr. SMITH. I have no questions.

Mr. SCHEUER. Congressman Manual Lujan.

Mr. LUJAN. I don't have a statement. I just want to welcome Tony Calio, because he's been one of the guys in the trenches on this right from the very beginning, and has been tough in the negotiating. But, Tony, I'll just say that I'm glad we have guys like you that are tough in protecting the proper interests.

I'm pleased we're moving in the direction of commercialization. It's a good example of, you know, all of Government research. The only reason we ought to be doing any research is to get it out there where it will be for the benefit of the public. And this is a good first effort, leading to someday maybe having a commercial shuttle or maybe condominiums up in a space station or whatever may be.

So, it's a good beginning, Mr. Chairman, and I'm pleased to be here today, and I'm glad Tony's here also.

Mr. SCHEUER. I appreciate those remarks and I join in them. I only want to add one remark before you start your testimony, Mr. Administrator. We've paid our respects to the marvelous cooperation between the executive branch, the Congress, and industry; and it has been noteworthy and your leadership has been noteworthy.

I also want to give credit and give thanks to all of my colleagues for the wonderful bipartisan, nonpolitical, straight, professional way in which they have dealt with this matter. I think that has also played a significant role in how we have brought this matter to fruition. And I want to thank my colleagues to my left, to your right, for their terrific cooperation.

OK, Mr. Administrator, your testimony will be printed in the record in full, so why don't you take such time as you may need to chat with us informally about your plans for Eosat?

**STATEMENT OF ANTHONY J. CALIO, DEPUTY ADMINISTRATOR,
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DE-
PARTMENT OF COMMERCE**

Mr. CALIO. Thank you, Mr. Chairman, members of the committee. With your permission, then, I would submit my statement for the record, and I would like to summarize and make a few informal comments regarding the specifics of the Government's pro-

posed agreement with the Earth Observation Satellite Co., and then I would be very happy to answer any questions.

I'd like to pick up on a note, though, that sort of pervaded the entire discussion by the committee members, because I want to also express, from the administration's side, it's been a long arduous task with a lot of conflicting notions, and a lot of difficult technical ideas that had to be consolidated and put together.

And I must thank, both for the Secretary and myself, the hard work of the many men and women in industry and Government who made this happen, and in Government, both the legislative and executive branch, who worked cooperatively to make this all come to this particular point. And so, for Secretary Baldrige and myself, we sincerely thank the many men and women who have worked hard to make it possible.

With that, I'd like to start off with saying that the administration believes that we have negotiated a contract which is both fair and cost effective. In short, it is an agreement which benefits both parties. And more importantly, it is an excellent arrangement for the American taxpayers, and I hope to prove that later on this afternoon.

This has been and remains a primary concern of the administration, and I know it is of paramount concern of every member of Congress, especially this particular committee. Accordingly, I would like to point out that while the present proposal retains most of the technical specifications, described in the September 1984 report to Congress, it goes much further, particularly in regard to the business arrangements in insuring and improving the benefits for the American taxpayer.

The modified agreement also enhances certain technical arrangements. In brief, the modified contract proposal requires that Eosat will provide two new satellites and a new ground station for a fixed price of \$250 million. A fixed price, no changes, regardless of what happens, other than—and I don't think that will happen—a breach of contract, Eosat will provide two new satellites, a new ground station for a fixed price of \$250 million.

Now, those satellites, the satellite hardware, will continue present capabilities, and will also provide new improvements. Among them, the new satellites will contain thematic mappers, substantially identical to what we have on Landsats 4 and 5 today. But in addition, a new black and white band with ground resolution improved from 30 to 15 meters will be added.

A new onboard processor, to allow for aggregation of larger scale thematic mapper data, will also be added. This will lower the data rates and give synoptic coverage, and provide new band options for such applications as agriculture.

Eosat will also consider—consider, and I underline again consider—additional thermal bands for Landsat-7, at no expense to the Government. The new ground station will have upgraded data processing capabilities. They plan to produce 50 scenes per day as opposed to our current capability of 13 scenes per day, and it will be less labor intensive than we have it in our current system.

The program life is 10 years, and the Government will provide funding only during the first 5 years.

In addition, the modified contract proposal requires that Eosat fund all capital costs over \$250 million, except for the two launches which will be funded by the Government, and for which new budget authority of approximately \$45 million is being requested. We are confident that no additional funding requests beyond the \$250 million agreement with Eosat, the launch costs, and the cost to operate four and five systems for its lifetime will occur.

To repeat, Eosat will fund all other expenses for the Landsat satellites. And finally, under the terms of the modified proposal, Eosat would market all unenhanced Landsat data. Moreover, the company will be entitled to retain all revenues from data sales, including a prorated share of access and royalty fees paid by foreign ground stations.

Eosat would be allowed to terminate marketing at anytime, and can terminate operations four months after the launch of Landsat-6, but only if the cumulative revenues fall below 65 percent of the projected revenues before the launch of Landsat-6, or below 60 percent after the launch of Landsat-6. I'll get into that a little bit later.

However, even under these conditions Eosat will still be obligated to build, launch, and check out Landsat 6 and 7, and to provide the ground station, all for a fixed price of \$250 million.

Mr. Chairman, the process of transferring NOAA's Landsat satellites to the private sector has been difficult, as we've indicated, it's been a long and arduous task, but the administration's view is that it has been well worth the time and effort spent. We look forward to completing this process in the near future, and we look forward to continuing to work with Congress to bring this matter to fruition.

And we thank the Congress for its advice, its interests, and its assistance and leadership in making it possible. And I'll be happy to answer any questions that you and other members might have.

[The prepared statement of Mr. Calio follows:]

STATEMENT OF
ANTHONY J. CALIO
DEPUTY ADMINISTRATOR
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT
AND
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES
JUNE 13, 1985

Mr. Chairman and Members of the Subcommittees:

I am pleased to be here to discuss the Administration's proposal for transferring the National Oceanic and Atmospheric Administration's (NOAA) Landsat Satellites to the private sector. I appreciate the opportunity this hearing gives us to set out for public review the Administration's proposed contract with the Earth Observation Satellite Company (EOSAT), the arguments for the proposal, and the excellent arrangement we have been able to obtain for the American taxpayers.

The best way to begin is to briefly explain how we got to this point and then to explain the draft contracts.

In February, 1983, President Reagan signed a decision memorandum authorizing a formal Landsat commercialization effort. Secretary Baldrige then established the Source Evaluation Board for Civil Space Remote Sensing (SEB/CSRS) empowered to issue a formal Request for Proposals (RFP), evaluate proposals submitted, and report their findings to him.

The primary goal of the competitive process was "to establish a commercial U.S. civil operational land-observing satellite program..." to "...begin operation after the present Government Landsat system. This is being done to maintain U.S. leadership in remote sensing from space and to foster the economic benefits of such data for the private and public good..." (RFP, page i). In meeting this goal, one firm condition is that the commercial program meet Government policy requirements; principally National Security and international considerations.

The Government was also seeking costs lower than those projected for the continuation of a Government- managed and operated land observing satellite system. This includes periodic replacement of the space system as failures occur, replacement or augmentation of ground equipment as wearout occurs, or to improve products in response to market demands.

The Source Evaluation Board included representatives from the Departments of Agriculture, Defense, Interior, State, and Commerce, and the National Aeronautics and Space Administration (NASA). Additional staff and logistical support were provided by NOAA, NASA, the National Bureau of Standards, and the Departments of Defense, State and Interior.

A schedule was established leading to presentation of the Board's findings and recommendations to Secretary Baldrige in May 1984. The major steps included: (1) development of the RFP and establishment of qualification criteria and evaluation factors for the proposals; (2) circulation of a draft RFP to interested persons and/or organizations for comment; (3) review of the RFP by appropriate Executive Branch and Congressional officials; (4) issuance of the final RFP; (5) receipt of proposals; (6) interim evaluation and determination of proposals within the competitive range; (7) clarification of offers within the competitive range through oral and written response to questions; and (8) final evaluation, scoring, and a report of findings.

The RFP provided that no proposal could be considered if it were not acceptable with respect to:

- National Security;
- Foreign policy;
- Understanding the Government requirements
in the RFP; and
- Particular stipulations of the RFP.

In addition, the RFP stated the evaluation factors which included costs as "...of equal importance to all other factors combined." (RFP, page XI-1). The RFP further stated "Cost to the Government will be a major factor in review of the proposals. Therefore, it is the Government's desire that the offeror be prepared to develop and operate follow-on systems without Government subsidies. However, to facilitate rapid commercialization, an offeror may elect to include in his proposal mechanisms for short-term Government financial assistance..." "It is the Government's intention that...the private operator assumes the major financial risk over the longer term." (RFP, page III-5).

Seven proposals were received by the official closing date for the RFP, March 19, 1984. The offerors were:

- (1) Eastman Kodak Co., Rochester, NY;
- (2) Earth Observation Satellite Co., Arlington, VA;
- (3) Geospectra Corp., Ann Arbor, MI;
- (4) Miltope Corp., Melville, NY;
- (5) Milton A. Schulz, Williston, ND;
- (6) ~~Space~~ Access Corp., Marina Del Rey, CA; and
- (7) Space America Corp., Bethesda, MD

After initial evaluation, the Board found three proposals to be within the competitive range. These were:

- Earth Observation Satellite Company
- Eastman Kodak Company
- Space America

These offerors proposed programs with the necessary satellite(s), a ground system to control the satellite and to produce satellite-acquired data, and a marketing plan to sell that data. All addressed the major features of the RFP. All proposed to satisfy, at least minimally, the requirements for National Security and international considerations.

Each of the three proposed a program providing nominal continuity after the demise of Landsat-5. The likelihood of success in meeting the schedules contained in the proposals varied among the offerors and was taken into account in the evaluations and in the projected schedules used to compute likely costs to the Government.

Each of the proposed systems would continue to provide multispectral data functionally equivalent to the Multispectral Scanner data from Landsats 1-5 and, hence, compatible with existing Landsat data processing systems. In addition, each would provide some technological advance over present sensors and systems. These varied both in degree of advancement and the schedule on which they were proposed.

On May 29, 1984, the Secretary selected the proposals of Eastman Kodak and EOSAT as the best proposals and directed that negotiations start with both companies toward definition of firm contractual agreements. The two firms were notified of their selection for further negotiations, and initial meetings were held with each firm. Both firms were informed that their technical approaches were acceptable, but their financial proposals were unacceptable as submitted.

Revised proposals and the refined financial analyses all confirmed that expected Government liability over the life of the program would have an adverse effect on efforts to reduce the Federal Budget. Accordingly, after consultation within the Administration, the President concurred in a decision by the Office of Management and Budget Director Stockman and Secretary Baldrige that Government financial support for the establishment of the commercial system should be limited to: (1) the run-out of Government cost for operating Landsats 4 and 5; and (2) a maximum of \$250 million of new budget authority for the commercial follow-on system. Both offerors were notified of this decision on July 20, 1984, and were requested to revise their proposals accordingly. EOSAT reduced requested Federal financial support in a proposal revision that also included certain technical changes, but Eastman Kodak declined to revise its proposal to meet the Government's conditions. As a result, since August 1984 we have been negotiating with one company, EOSAT.

EOSAT is a joint-venture partnership formed by Hughes Aircraft Company (HAC) and RCA Corporation (RCA), in accordance with the provisions of the Uniform Partnership Law of the State of Delaware, for the expressed purpose of establishing a private sector U.S. operational land observation and data service program. HAC and RCA each have an equal interest in this joint venture.

In June 1984, Congress passed the "Land Remote Sensing Commercialization Act of 1984" which was signed on July 17 by the President, who said the Act was an outstanding example of cooperation between the Administration and Congress. In addition to providing a framework for the transfer to the private sector of both the current Landsat 4/5 system and the follow-on commercial system, the Act dealt with licensing, R&D roles of Federal agencies, data archiving and several other matters. The provisions of this Act, and the Administration funding limitation, caused EOSAT to revise their program but still meet the requirements of the RFP.

The provisions of Public Law 98-365, and the Administration funding limitation, caused EOSAT to revise their program but still meet the requirements of the RFP.

Their Commercial Land Remote Sensing Program provides for the construction, launch, and operation of additional Landsat satel-

lites; the development of a supporting ground system; and the sale and distribution of remotely sensed data to the world at large.

In September 1984, the Secretary submitted a report required by the Act to your Committee and to the Senate Committee on Commerce, Science and Transportation which described the proposed decision to enter into a contract with EOSAT subject to fund availability.

In the course of developing the request for necessary funds, certain of the financial arrangements were not considered by the Administration to be in keeping with the President's requirement that the contractor accept the majority of the financial risk over the long term. As a result of these discussions, an agreement was reached as described in the President's FY 1986 Budget. The agreement requires that the contract stipulate two spacecraft for a fixed price of \$250 million in new budget authority, which would result in data continuity from the new system for a period of at least six years.

In response to the Administration requirements, EOSAT agreed, by its March 1985 revised proposal, to meet the requirements of two spacecraft, at a fixed price of \$250 million, providing over six years of data continuity. We completed the analysis of the EOSAT proposal several weeks ago. The Administration transmitted to the Congress on May 24, 1985, a Supplemental appropriation request for FY 85 of \$75 million and a FY 86 request for \$50

million. On June 7, 1985 the Administration transmitted to Congress a draft legislative proposal authorizing appropriations of \$50 million for FY 1986, \$90 million for FY 87, \$54 million for FY 88, and \$26 million for FY 89. The total amount authorized includes \$45 million for launching two Landsat satellites. The Administration bill also authorizes an appropriation of \$30,604,000 for FY 86 for operation of the existing satellite system. Currently we are completing the negotiations with EOSAT towards reaching final agreement on a contract that would satisfy the requirements of both the Landsat Act and the Administration. We expect to complete those negotiations in the next two weeks, and be prepared to sign a contract and initiate work as soon as the Congress approves the 1985 Supplemental Appropriation request.

I will briefly review the major points of the agreement reached to date with EOSAT.

While the overall technical proposal remains the same as that described in the September 1984 Report to Congress, negotiations thereafter resulted in several changes to the technical proposal and related business arrangements to be included in the contract which improve the benefits that the American taxpayers are getting in this commercialization process. The latest EOSAT modified proposal is as follows:

- o Two satellites and a new ground station are to be provided by EOSAT for a fixed price of \$250M.
- o Satellite hardware will continue present capabilities with improvements:
 - the new satellites will contain Thematic Mappers substantially identical to Landsats 4 and 5,
 - a new black and white band with ground resolution improved from 30 to 15 meters will be added,
 - a new onboard processor will be provided to allow Thematic Mapper data to be aggregated at a larger scale, thus lowering data rates and giving synoptic coverage and new band options for agriculture,
 - additional thermal bands, at EOSAT's expense, are being considered for Landsat 7.
- o The new ground station will have substantially more data processing capability (50 scenes/day as opposed to the current 13/day) and be less labor intensive.
- o The program covers ten years. Government funding occurs in the first five years.

- o EOSAT will fund all capital costs over \$250M except for the two launches which will be funded by the Government and for which new budget authority of approximately \$45M is required. We are confident there is no situation in which the Administration would come to you for any additional funding for this contract beyond the \$250 million to EOSAT, the launch costs, and the cost to operate the 4/5 system for the duration of its lifetime.

EOSAT will fund all other expenses beyond the budgeted Landsat 4 and 5 operational costs. This includes market development and administration, and data distribution for Landsats 4, 5, 6 and 7, as well as spacecraft and data processing functions for Landsats 6 and 7.

- o EOSAT would market all unenhanced Landsat data and be entitled to retain all revenues from data sales, including a pro-rata share of access fees and royalty fees paid by foreign ground stations under an existing Memorandum of Understanding with the government. If cumulative revenues fall below 65 percent of the projected revenues before the launch of Landsat 6 or 60 percent thereafter, EOSAT can terminate marketing at any time and can terminate operations four months after the launch of Landsat 6. However, EOSAT still will be committed to build, launch and check-out Landsats 6 and 7, and provide the ground station for a fixed price of \$250M.

It has been a long and sometimes difficult task to bring this process to its present state. We look forward to a completion of this commercialization in the near future.

This concludes my prepared statement. I would be glad to answer any questions you might have.

Mr. SCHEUER. Are there any unresolved issues at this point in your negotiations with the Eosat people?

Mr. CALIO. Yes, there are a couple of them. The first one, of course, has to do with the signing of the contract, and the associated activities for transfer of our current efforts to Eosat.

Mr. SCHEUER. Well, that's not an issue. That's just part of the process.

Mr. CALIO. Well, but we've got to nail that one down. The issue of open skies—let me back up and I'll try to answer one of the questions I think that Mr. Nelson asked. Have we abided by the precepts of the legislation in insuring national security and international relations? Yes, we have.

Two of the outlying considerations were open skies and nondiscriminatory distribution of data, and that is written in the contract. Eosat will abide by the agreements that have been established, first by NASA and now with NOAA, with foreign nations.

Now, the question of if there is a challenge on sovereign rights by a foreign nation, Eosat has asked the Government to step forward and participate in that legal issue. That has not been resolved, we have worked it out among ourselves as to what we would do, but we have not received the final signoff by the Justice Department, and that they would enter into any legal suits in protecting the U.S. company on challenges about sovereign rights.

There's one more that I think is still open, and that has to do with the transfer of equipment at Goddard at the end of the program. We are discussing this with Eosat; the terms and conditions of that being will they accept the equipment as is or do we have to make any modifications to that equipment.

Those are the three open issues that I know of that currently have to be resolved.

Mr. SCHEUER. Let me just ask you one more question before I turn to Chairman Nelson. I can understand how you can, by contract, require them to maintain, keep the existing plant and equipment in good order. But I'm a little puzzled as to how you can require them, in the contract, to improve their product and their service by taking advantage of the availability of the new technology as it might develop, and in response to market demand for new technology that it is developed in our country or might be developed by the French or the Japanese or somebody else.

How can that be accomplished, and is that provided for in the contract? And I intend to ask the same question of the Eosat witness.

Mr. CALIO. I think the answer to that is, looking at this entire package, it is a high risk endeavor for Eosat. There are going to be points in the program for the next 2 or 3 years where considerable amounts of money are going to be invested on the part of Eosat in order to fulfill their agreement with the Government, which is the two satellites and the ground station for \$250 million.

I believe Eosat is into this not just to get this \$250 million contract, but they believe—and they'll have to speak for themselves—that there is a market here, there's a market potential, and there's an opportunity to make some profit, that has driven the company to capitalize in that future.

So, I think it's going to be market-driven primarily. In order to satisfy and to be able to capture and develop, or develop and capture, a very important remote-sensing market, forces will be to drive or to force them to use new technologies, to take advantage of various efficiencies in the future, and help improve their competitiveness in the overall international marketplace. It's really more a question for Eosat than it is for me, but from my vantage point, that would be a very important driver in the whole system.

Mr. SCHEUER. Chairman Nelson.

Mr. NELSON. Thank you, Mr. Chairman. And I will ask that question of Mr. Williams. Specifically when you take the witness chair, I want to know what new technology ought we be having that we don't have now? What should we look toward for new technology on a second generation that will come later on? And what capability would that new technology give us that we don't have now? And how does that compare with what we expect the technology to be on the French system?

Now, with regard to Dr. Calio, let me just walk you through a couple of questions here, and then, Mr. Chairman, I'll turn it back to you, and when everybody else is finished up, I've got a bunch of other questions. But I'll just—I'll defer those until later.

How much did Landsat-5 cost the U.S. Government?

Mr. CALIO. That's a difficult question to answer because 4 and 5 were developed together. I think the total cost for the program—well, there are several pieces of it—Landsat-4, Landsat-5—

Mr. NELSON. Just ballpark it.

Mr. CALIO. I would say \$250, \$300 million.

Mr. NELSON. I couldn't hear you.

Mr. CALIO. The total program was about five and a quarter, \$525 million, and I would guess for the second satellite it would be somewhere around \$250 to \$300 million.

Mr. NELSON. OK. Now, that was years ago.

Mr. CALIO. Well, it was 1978, 1979 timeframe.

Mr. NELSON. Right. So, if you had to build it today, what would a copy of Landsat-5 cost?

Mr. CALIO. About 325 would be my guess, 325 or 350.

Mr. NELSON. Now, Eosat is charging \$250 million for Landsats 6 and 7, is that right?

Mr. CALIO. That's correct.

Mr. NELSON. So—

Mr. CALIO. And a ground station.

Mr. NELSON. And a ground station. So, that's no more than 125 per Landsat, for 6 and 7.

Mr. CALIO. If you look at it that way, that's correct.

Mr. NELSON. All right. Will 6 and 7 represent any kind of major technological improvement over Landsats 4 and 5?

Mr. CALIO. Yes.

Mr. NELSON. What?

Mr. CALIO. Well, as I indicated, there will be a new panchromatic black and white band added, increasing the resolution from 30 meters to 15 meters. And there's a new onboard processor that would allow the aggregation of data, like synoptic data, at a grosser scale. So you're not looking at the fine detail thematic mapper from wall to wall, you're really looking at it aggregated up so that

you can get a much grosser scale, more—I forget the numbers, but it would be like taking multispectral scanner data with thematic mapper data. Excuse me, I'll ask a question so I don't—

[Brief pause.]

Sixty meters, OK. So it goes—so you have two capabilities. You have the standard thematic mapper of 30 meters, then you have the capability in the black and white band to increase that resolution to 15 meters. And by using this emulator, which it's called, you can aggregate the thematic mapper data to 60 meter resolution. So you have a two-way capability with the instrument that would be put onboard Landsat-6, which is a tremendous increase in capability.

Mr. NELSON. OK. To summarize then, what would cost us to build Landsat-5 today, at approximately \$325 million roughly, we are now purchasing at \$125 million max, and getting new technology in addition. Is that a fair statement?

Mr. CALIO. Correct.

Mr. McCURDY. Will the gentleman yield for just a moment?

Mr. NELSON. Certainly.

Mr. McCURDY. Mr. Chairman, I apologize for coming out of turn here. I have a markup that's—

Mr. NELSON. I understand.

Mr. McCURDY [continuing]. Ongoing and I've been buzzed here and I've got to run over to it. I wanted to ask one question of Dr. Calio before I leave. I think it's important for us and the committee to know exactly where we are today legislatively. We've talked about the contract and the technical.

The Senate, is to my understanding, is going to have the Landsat in the supplemental appropriations, but is it accurate, is it true that because the request was not—from the administration was not submitted in time when the House marked up its supplemental, that it was not included in the House version? And where do you expect us to be between the House and Senate versions, and what should we be prepared for?

Mr. CALIO. I think it's correct that we did not submit the supplemental in time for the House appropriations markup, so it's not included in the House right now. I understand this morning the Senate authorization group, they did markup this morning, right?

Mr. WILLIAMS [Mr. Chuck Williams, president of Eosat]. Yes.

Mr. CALIO. Completed a markup for the total cost of the program. It would be appropriate to have a House authorization for us to be able to proceed, because we have to have a—before we can submit our reprogramming action to you to be able to sign the contract, it's important that Congress state its position or its views on this particular activity.

Mr. McCURDY. Well, it's my understanding—and correct me here, but if we go to conference on a joint Senate/House supplemental appropriations bill, which includes the moneys, and the House accedes to the Senate position as to Landsat, then will that complete the legislative requirements for the appropriations?

Mr. CALIO. Yes, providing there is no point of order because there is no authorization on the House side.

Mr. McCURDY. I wanted to—for all of us, who I think this committee has been very, very supportive and bipartisan for on this

issue, that we understand exactly where we are and that we work together to insure that this proposal goes forward. And I thank the gentleman for his comments, and I thank the gentleman for yielding.

Mr. SCHEUER. We're going to have to move an authorization on the floor within the next 2 weeks, and we'll be talking to you about that. Are you finished, Dave?

Mr. McCURDY. Yes, sir. Thank you.

Mr. SCHEUER. Congresswoman Claudine Schneider.

Mrs. SCHNEIDER. I'd just like to briefly ask, what will happen if either Landsat 6 or 7 fails prematurely as Landsat-4 did?

Mr. CALIO. We would have the loss of the spacecraft. We would be out of service.

Mrs. SCHNEIDER. And would we be insured?

Mr. CALIO. We be insured? The Federal Government?

Mrs. SCHNEIDER. Well, yes.

Mr. CALIO. No. We will have paid the \$250 million for the two satellites.

Mrs. SCHNEIDER. And it would just be——

Mr. CALIO. If we have an inadvertent failure, we've lost that satellite. I'll ask the question to Eosat. No, we will not have insurance.

Mrs. SCHNEIDER. So there will be no insurance for Landsat 6 or 7?

Mr. CALIO. No, ma'am. We don't have any today on our current spacecraft that the Government launches.

Mrs. SCHNEIDER. Well, that doesn't mean anything. Perhaps it's time to change our ways considering those are taxpayer's dollars that are being lost in space.

Mr. CALIO. That's correct, both ways.

Mrs. SCHNEIDER. This is a thorn that is completely in my side and the side of many of my constituents and I know many of my colleagues in this Congress. Everybody can get hyped about sending our various satellites into space, but I think that we have to feel some level of fiscal responsibility here.

Has there been any effort on your part to pursue the potential of insuring these?

Mr. CALIO. No. We follow the practice of NASA in this particular case. We are—the Government insures itself, and we do not seek insurance in this particular case.

Mrs. SCHNEIDER. Well, perhaps you could pursue a request by this committee to investigate the potential of insuring for the future. I have a difficult time justifying, and you haven't provided us with any justification, as to how we can feel comfortable in such launches without knowing that we are insured. And it seems to me that certainly I would like to see the Federal Government, or somebody, do an assessment as to what the potential of insuring those satellites might be. I think it might be a good idea. And that's just my own opinion, but I haven't met anybody that told me that they didn't think it was a good idea and be able to give me good reasons why not. So, perhaps you could provide us with some——

Mr. CALIO. If it would just be the cost of the insurance, we have not priced out what the insurance cost would be associated with

Landsat 6 or 7, nor have we included it in our budget considerations.

Mrs. SCHNEIDER. And maybe we should look at a cost/benefit analysis then of the risk involved and the expenditures. But I think that, for your benefit, this is something that I am going to pursue, if not here than perhaps elsewhere. But I think that it's something that we owe to the taxpayers whose money we are using for this project.

Are any of these satellites that are being designed going to be serviceable in space? In case there is a failure up there and we can't get them back, will we be able to service them in orbit?

Mr. CALIO. I'm trying to figure out how to answer that question because we have a satellite up there right now that can be serviced in space and we're not going to service it. Landsat-4 can be retrieved and its modules can be changed out in space.

Mrs. SCHNEIDER. But technologically, would it be possible to service 6 and 7 in orbit?

Mr. CALIO. Technologically, yes.

Mrs. SCHNEIDER. OK. Well, that's enough of an answer. Thank you, Mr. Chairman.

Mr. SCHEUER. Congressman George Brown.

Mr. BROWN. Mr. Calio, when you talk about the improved technology allowing a reduction in ground resolution from 30 to 15 meters, what are the current limits placed on civilian satellite resolution by national security considerations?

Mr. CALIO. Ten meters is—field of view.

Mr. BROWN. Is that an action that's been taken recently or—

Mr. CALIO. It's been around for a long time.

Mr. BROWN. A long time?

Mr. CALIO. Yes.

Mr. BROWN. Could you cite the basis for that? I've been under the illusion that it was 25 meters, reduced from 80 in the Carter Administration.

Mr. CALIO. The number that pops into my head is Presidential directive No. 37, produced by President Carter, by the 1978, 1979 timeframe.

Mr. BROWN. All right. I'll ask the staff to get me that source and we'll see. What are the factors limiting the life of the satellite? I notice that the planned life for 6 and 7 are about 3 years. What are the factors that limit 4 and 5, for example? Is it—

Mr. CALIO. Well, power—in 4 it's the power consideration. What happened in Landsat-4 is we had a design problem with the power feeding off of the solar rays that was fixed before we launched 5. And so, we were power limited and consequently could not use the thematic mapper because of the power drain on the spacecraft.

I'm trying to go back through the family of Landsats to think about what some of the problems have been. It has usually not been the instrument, it has been the spacecraft bus, mostly power, and the mechanical failures on the spacecraft.

But power and data distribution have been, if I recall, the major problems on lifetime—data distribution systems.

Mr. BROWN. Is there any technical reason why they couldn't be given an enhanced lifetime?

Mr. CALIO. Not that I know of. I would like to ask Chuck—

Mr. BROWN. Well, were there policy considerations that led to deciding that a 3-year lifetime, or a cost consideration——

Mr. CALIO. Well, I think there are cost considerations because of the redundancy that might be necessary in the spacecraft. To go to the reliability numbers that would go for a 5-year life, there are added costs for lifetime.

Mr. NICHOLS [Mr. Warren Nichols, vice president, Santa Barbara Research Center]. Our contract would be to require a 5-year life on——

Mr. CALIO. Vice president, Santa Barbara Research Center.

Mr. BROWN. Correct. Thank you. What is the situation with regard to responsibility for research and development in improving the technology, or is there any need to be concerned about that in the light of the technological capabilities of the classified systems?

Mr. CALIO. Well, you have several questions wrapped up in one. Could you separate those out?

Mr. BROWN. Well, I'm thinking back to the situation that developed with regard to communications satellite R&D when we turned it over to Comsat.

Mr. CALIO. Right. But that wasn't a military issue, that was just a——

Mr. BROWN. I know that wasn't. And we do have the military issue that complicates this.

Mr. CALIO. No, I don't see any problems with the military on that standpoint, but I do think that we must continue the research and development, research and technological development, of the instrumentation. NASA has a program onboard, ongoing, right now with a programmable spectrometer which talks about the far term, talking about 10 to 15 years from now. But in the near term, or the immediate new term, 5 to 7 years from now, there is not anything being actively pursued. And it would seem to me that it is appropriate that such R&D continue in the Government and be spun off to industry.

Mr. BROWN. Well, I don't want to repeat the problems that we had with Comsat, where we got out of the R&D and then we saw a need to get back in again, and there was a disruption in the process. And I would hope that we would determine a reasonable R&D program, and determine how it would be financed and carried out, and it would be carried out by either EOSAT or NASA, as the case may be.

And I know you don't speak for NASA now, but do you feel relatively assured that that will not cause a problem in the future?

Mr. CALIO. No, I don't feel comfortable right now. I think that will be part of the 1987 budget process, as to whether we see the appropriate funding and the appropriate R&D responsibilities——

Mr. BROWN. Would it be appropriate for this committee to keep that in our attention as a——

Mr. CALIO. It sure would.

Mr. BROWN. Let me ask you about the marketing aspects, although you will not be responsible for that. It seems to me that this problem, that I think was brought up earlier, about marketing whole frames or fractional frames is a real example of—I think Mr. Walker brought it up—of a failure to recognize the needs for aggressive marketing.

It seems to me that there is conceivably a market, amongst say cities or counties or units of small geographical areas, for data that might meet their particular needs. A city might want an annual satellite photograph for something, and it might be just a fraction of a frame.

Will the potential of the systems that we're contemplating allow marketing to the customers who might have a need for less than a whole frame, on a basis which is economical to provide, so that we could look to expansion of the market in that sort of a situation?

Mr. CALIO. Could I turn to Mr. Williams for that? His answer is yes.

Mr. BROWN. The answer is yes. They're going to be aggressive marketers then?

Mr. CALIO. I sure think so.

Mr. BROWN. All right. Let me ask you one final question. It had entered into the minds of Congressmen in connection with this, and other examples of U.S. divestiture of potentially commercially profitable operations, that there might be a role for some sort of an agreement in which the U.S. Government could continue to have an interest in some of the profits that might ultimately be returned.

I recognize that that's in one sense immaterial since we always get a piece of the profits anyway through the tax system, but did that factor enter into the consideration here or would it be appropriate to consider it?

Mr. CALIO. Not now. I don't say not now because of time. I'm saying not now because the deal that we've negotiated—

Mr. BROWN. Look 10 years in the future.

Mr. CALIO. Because at the outset we had notions like that, depending upon how we would—and we've talked about sharing profits depending upon how things worked out. But the deal that's been negotiated now, there's no room for profits anywhere. It's a tight program, and it's going to be several years before EOSAT does indeed turn a profit.

But downstream I could see where that—not with the arrangement we've put together now, but on other concepts, I could certainly see that notion being applied.

Mr. BROWN. Well, it may not be a good notion, but I just wondered if it had been considered. Thank you, Mr. Chairman.

Mr. SCHEUER. Dave Monson. Oh, I'm sorry, Bob. Congressman Bob Walker of Pennsylvania.

Mr. WALKER. Thank you, Mr. Chairman.

Mr. SCHEUER. A very honored ranking minority member of a subcommittee I chaired of this full committee 6 years ago, and a more cooperative and more involved ranking minority member never existed.

Mr. WALKER. Thank you, Mr. Chairman. I was interested in your statement a couple of minutes ago with regard to what Mr. Brown was asking you on power; the fact that one of the limiting aspects on flying these satellites, and probably the most limiting aspect, is power.

If there were on station a permanent power source that a satellite like Landsat could tap into, we could substantially then increase the life of that satellite, is that—

Mr. CALIO. I—remember how we get power to the satellite through the solar cells, and then during dark periods we store up power. So, it's not a question of charging an old set of batteries.

Mr. WALKER. Yes, I understand. But the fact is if you had a permanent power station you wouldn't rely on those solar cells, then you would figure out a way to get the power from that power station to the satellites, say by microwaving it to the satellite.

At that point,—if power is the limiting factor, what I'm asking is, wouldn't we have the chance to, at that point, extend the life of multimillion dollar satellites fairly substantially?

Mr. CALIO. For that technical aspect, yes. Excuse me, I'm trying to dream with you on that transmission of the power while the satellite's going in polar orbit, how we would be able to beam through microwaves, or whatever, that much power.

Mr. WALKER. Well, just assume that that's technically feasible. I'm told by some people, who know much more about it than I do, that that is in fact something which could be done technically—

Mr. CALIO. Power station up there, yes. Transmitting it to a polar orbiting satellite a thousand kilometers in space, I think is going to be a tough job, but it probably could be done.

Mr. WALKER. And what I'm saying is, if that in fact existed, you would extend the life of this type of satellite, a multimillion dollar satellite, fairly substantially. Is that—

Mr. CALIO. From that aspect, yes.

Mr. WALKER. And the power generation is the real self-limiting factor for the most part?

Mr. CALIO. Well, not just in the power generation itself, it's also in the distribution of that power, because one of the problems with Landsat-4 was the cabling going from the solar cells into the power distribution box. So, it's not just the—it's the wiring that goes—

Mr. WALKER. Yes, but that's essentially then a technical failure rather than a limitation because the power runs out.

Mr. CALIO. Well, strangely enough, all the failures on Landsat, if I recall, have been sort of that way. They've not been system failures from a reliability standpoint, it's been a peculiar event that has occurred. I think that's right. As a matter of fact, there was an exhaustive effort between 4 and 5 to make sure we worked out all of the component and system problems.

Mr. WALKER. Well, the only reason I raise the question is—and I thought it was very important when Mr. Brown raised it with you—is it's not only true of Landsat, it's true of a lot of satellites, that I think the bottom line is that the whole power question is a key question, it's going to be a key question with regard to space stations.

There are a whole lot of things that this committee considers, where power becomes an issue, and I am beginning to have severe questions myself as to whether or not we're addressing that in a manner which really serves commercial needs. And it's particularly appropriate, I think, to raise it as we move toward our first major commercialization effort, to raise the question of the reliability that a commercial vendor would like to have.

It seems to me that when a commercial vendor flies a bird, he would like to think that that particular bird is going to serve him

for a fairly long period of time, at least the period of time that it takes him to depreciate the expense that went into it.

And that if power is a limiting factor, then one of the things that we need to be doing, as we evaluate technology, is figuring out ways to meet those power needs. And as I say, I am told that there is some technical feasibility to the business of putting power generation stations in space that could serve a multiplicity of needs of satellites on orbit, stations on orbit, commercial factories on orbit, and that kind of thing. And that that becomes an alternative that we have to explore in the commercial aspect.

One final thing, and that is to go back to the question of the frames. I really would like to know, for future reference of dealing with some of these issues as the Government attempts to commercialize more and more of what we're doing in space, how a situation like that could arise and how it was ultimately corrected?

Mr. CALIO. You're looking at the man who was on the watch in both places. When Landsat-4 flew the first time with a thematic mapper onboard, in NASA as an experimental program, we tried to establish a reasonable price structure knowing that it was not going to be a cost effective price structure, and did what you just said.

Then when we turned over—and I moved to the other side of the fence and joined NOAA—when we turned over the operation of the thematic mapper to NOAA, the operating agency, this became apparent to the NOAA operations people. And effective July 1, the price of that quarter scene will be that of a full scene.

So, it's looking at it from two different aspects. We, NOAA, now look at many of these aspects from operational standpoints, and still not from a business standpoint, but we're getting a little better. Where NASA, I think, pretty much looks at well, will the thematic mapper work? What are the processing problems going to be associated with it? How do we get as many of these products out into the hands of the people who can really work with thematic mapper data tapes, to teach us how we can develop new applications for this data?

Mr. WALKER. So it was basically a development decision rather than a market decision, is what you're saying.

Mr. CALIO. And an operational decision, that's correct. And I was at the watch of both sides.

Mr. WALKER. I thank you. I think that's a helpful explanation. Thank you, Mr. Chairman.

Mr. SCHEUER. Congressman Norman Mineta.

Mr. MINETA. Thank you very much, Mr. Chairman. Mr. Calio, I must apologize for not being here earlier during your testimony, and I got in on just the tail end of this question that was being asked by Mr. Brown.

Up to this point with NASA and NOAA there's been a free-flow back and forth in terms of research questions or operational questions regarding the satellite. Now, under the new relationship you say that there will not be a problem in terms of that free flowing, free flow of information back and forth.

And I'm just wondering, if there—as I understand it, there's a subsidy in the contract as it relates to operations. But what about

the research part of this Landsat? Are there sufficient moneys in there?

Mr. CALIO. Let me back up one statement.

Mr. MINETA. Yes, sir.

Mr. CALIO. There is no subsidy in this contract for operations. The subsidy is for hardware, all of it, end-item specifications of deliverables. The \$250 million pays for two satellites and a ground system, no operations. The operations and marketing are being borne completely by Eosat for Landsats 6 and 7. There will be reimbursement to Eosat for the operation of Landsats 4 and 5, that the Government—those satellites currently operating.

When those two satellites are terminated, there'll be no further Government funds going to Eosat for the operation of Landsats 6 and 7. There will be no funds going to Eosat for research and development. That will take place either in Eosat for its own interests and purposes, or in the Federal Government based on its assessment of future needs within the area of remote sensing. So, there are no dollars being made available to Eosat for research and development.

Mr. MINETA. Well, is there a linkage of any kind between research and operations?

Mr. CALIO. The same way you drew the linkage between NASA and NOAA? The answer is no. Between NOAA and Eosat and NOAA and—Eosat and NASA, no.

Mr. MINETA. Then how do we make sure that as progress, let's say, is made by other countries, that we're able to keep up with the state of the arts in this area?

Mr. CALIO. I guess the same way, to some extent, the way it's done today. And Mr. Brown is going to talk about the communications field, we had a difficult task with that. I hope it doesn't happen like the communications field.

The notion is that—the idea that I'm thinking about, Mr. Mineta, is that through NASA's assessment and NOAA's assessment, and through conversations with Eosat and other U.S. companies involved in this activity, that we could be influential in formulating NASA's research and development program and in developing new technology. But there is no mechanism, no linkage, no legislation mechanism, other than the one that appears in the Landsat Act that mandates that we must do this.

Mr. MINETA. Well, how do we know then that the research that NASA does doesn't just sit on the shelf, and is it utilized in some manner then?

Mr. CALIO. And is it going in the right direction.

Mr. MINETA. Right.

Mr. CALIO. Well, we have a report coming to you, very shortly I hope, that's supposed to assess that. Let me just check where that is. We have a joint NASA-NOAA report talking about research and development that would be up for your review on July 19. And that is one mechanism, I can think of, that will give you an assessment, give you a view of our assessment of where that research and development is going. And then you have the opportunity, then, to take appropriate action.

Mr. MINETA. That will be coming up when?

Mr. CALIO. July 19, sir.

Mr. MINETA. And is that outlining sort of an ACTS-like approach?

Mr. CALIO. No, I don't think so. No, sir, it's nothing like ACTS. It will be more fundamental with this basic research and development needs.

Mr. BROWN. Would the gentleman yield briefly? That ACTS is spelled A-C-T-S, not A-X-E.

Mr. CALIO. Yes, sir.

Mr. MINETA. Thank you very much, Mr. Calio. Thank you, Mr. Chairman.

Mr. SCHEUER. OK. Mr. Calio, we have two or three Republicans who haven't had a chance to ask you questions. So, if you'd be willing, we're going to have to recess for about 15 minutes to get this rollcall vote, and if it's not too much of an imposition, I would ask you to wait so my distinguished Republican colleagues can have a chance to address that question.

Mr. CALIO. My pleasure, Mr. Chairman.

Mr. SCHEUER. So, we'll recess this hearing for 15 minutes.

[Whereupon, a brief recess was taken at 3:15 p.m.]

Mr. SCHEUER. The subcommittee will come to order. Mr. Calio, in the perhaps unlikely event that EOSAT withdrew from the contract and failed to perform, what recourse would the Federal Government have?

Mr. CALIO. Probably sue them on breach of contract.

Mr. SCHEUER. Well, apart from suing them. Could they terminate—I guess they could terminate the contract and take over the system.

Mr. CALIO. Yes, we could do that.

Mr. SCHEUER. The major—the owners of Eosat, I take it, are RCA and Hughes Aircraft. Hughes has been acquired by GM. Will GM be on the contract, and would Hughes be on the contract, and would RCA be on the contract?

Mr. CALIO. All right. Eosat is on the contract as of right now, but the——

Mr. SCHEUER. Yes, but Eosat has no assets, right?

Mr. CALIO. Right. Well, with a joint venture arrangement between RCA and Hughes, with liability going back to those two parent companies, to RCA and to Hughes. Now, you asked a question about General Motors and Hughes. I can't answer that question.

Mr. WILLIAMS. No——

Mr. CALIO. General Motors will not be on the contract. RCA and Hughes are separately liable, 50-50.

Mr. SCHEUER. They're each liable for half of the obligation.

Mr. CALIO. Yes, sir.

Mr. SCHEUER. They're not individually liable for all of it.

Mr. CALIO. I think that's correct.

Mr. SCHEUER. George, Congressman Brown, do you have any further questions?

Mr. BROWN. Well, there will be some minority members here shortly, but until they get here could I just ask you, while we're talking about competitive posture, the situation with regard to stereoscopic capability on the Landsat 6 and 7 equipment. I didn't

notice any reference to that in the data that we were provided with.

Mr. CALIO. No, sir, there is not from the current Landsat 6 and 7 that we've negotiated. Originally, when we had our first rounds of negotiation, it was there and that capability was taken out as a result of cost reductions.

Mr. BROWN. I understand, however, that the French SPOT has that capability and it may be very attractive to the petroleum industry people. Does that mean we lose a market to SPOT because we don't have it?

Mr. CALIO. They're going to lose some of the market, but—well, I'm not sure we're going to lose the market to our own oil and gas people. I think they'd still be interested in the higher resolution we have, and the seven bands that we currently have. The band discrimination provides a tremendous amount of information for oil and gas exploration.

Certainly stereoscopic capability is an added capability. My reaction is oil and gas will probably do both, but let me—Eosat agrees with that.

Mr. BROWN. Thank you.

Mr. CALIO. Can I come back to one other thing, Mr. Brown, if I may, Mr. Chairman?

Mr. SCHEUER. Excuse me. Are you finished, George?

Mr. BROWN. I was finished, but I think he wanted to respond further on another—

Mr. CALIO. I wanted to respond to a previous question having to do with R&D links, if I may, Mr. Chairman.

Mr. SCHEUER. By all means.

Mr. CALIO. I guess one thing we ought to have for the record, and this is certainly true in NASA's past experience, that certainly the precedent has been set in industry, Government R&D relationships, certainly in aeronautics. So, that does exist with a new thrust in NASA with the commercialization of space activities, their linkages between industry and NASA are improving with respect to R&D activities and commercial development.

So, certainly the precedent is there. I don't want to mislead you and say the linkages are there now for this particular activity, but certainly the precedent and the background and the knowledge, the people, and the interest is there. I think we have to put the links in place.

Mr. BROWN. Well, I think that we have potentially the adequate links. And of course in the area that we're not discussing here, the support for R&D coming from the classified agencies, we have a resource which ultimately will benefit this program. But I am concerned, as I have been for a number of years, that we are able to get the full benefit of all of the Government funded R&D, and that it's applicable to the civilian commercial programs, where it's appropriate that it would be on this matter of satellite survivability, which we were talking about a moment ago.

Last year the Congress directed DOD to provide a classified report on satellite survivability. It's a thorough and extensive report indicating all the activities that have been taken, and obviously it has some fallout in terms of survivability of civilian satel-

lites, it seems to me. I'm not sure that we're getting the benefit of those—

Mr. CALIO. Well, let me try to touch on that as well. I'll be a little vague, but try not to be too vague. Both RCA and Hughes do civilian as well as military work.

Mr. BROWN. I'm aware of that.

Mr. CALIO. Some of that activity, I think, even passes over through the companies to have some of the technological development—

Mr. BROWN. It's not supposed to pass over.

Mr. CALIO. Well, in the knowledge of, how you go about doing some of these things, and the redundancy and the like. I'm talking about instruments now. I'm talking about know-how in building spacecraft. And as Mr. Nichols reminded me during the break, you know, when you look at the reliability of this system, each of the spacecraft have a design life of 5 years. The term of the contract is, or the operation time is 6 years. So in reality we really have in one spacecraft almost the entire lifetime of the program. So, the second spacecraft can even be considered a spare, it's about a 1-year activity. That's No. 1.

No. 2, there have been redundancies built into this satellite design, in the multiplexers and the like. From their experience in building satellites, that really build in that reliability, give us the five-year lifetime. So, there is a transfer, whether it's an overt one or one within the capabilities of the companies, some of that does take place.

Mr. SCHEUER. Let me just follow up with the line of questioning I was into before. You have a contract in effect with RCA and Hughes in which they're singularly liable up to half of the volume of the contract, correct?

Mr. CALIO. We have a contract with Eosat in which—

Mr. SCHEUER. With Eosat, that's right.

Mr. CALIO [continuing]. In which RCA and Hughes are equally liable for 50 percent.

Mr. SCHEUER. Fifty percent. Now, Hughes has been bought by General Motors.

Mr. CALIO. That's correct. I think that's correct.

Mr. SCHEUER. Who controls Hughes now? Who do you deal with? Who do you call up?

Mr. CALIO. Well, I still deal with the same people in the Santa Barbara Research Laboratory and the Hughes Aircraft Co. Can I turn to the Hughes people and ask them that question?

Mr. SCHEUER. Sure. Do you want to come up to the table?

Mr. CALIO. This is Warren Nichols, vice president of Santa Barbara Research.

Mr. NICHOLS. We have no final answers, of course, as to what the acquisition of Hughes by General Motors really means.

Mr. SCHEUER. Pull the mike a little bit closer, if you would.

Mr. NICHOLS. All right, I'm sorry. We have no final answers as to what this acquisition really means. What we have been told very explicitly is it's the intent of GM for us to continue as we are. Hughes Aircraft Co. is a for-profit company. It's a fairly large company in its own right. I think the gross last year was in the order of \$6 billion. Every sign that we have been given is that we will be

allowed to continue doing what we do, as we do it, for an indeterminate period, which may go on a number of years.

We have no indication whatever that there is any radical policy change coming as a result of the new ownership. And I have talked with the president of the Hughes Co. in the past week on that.

Mr. SCHEUER. Mr. Calio, I haven't studied this and I haven't delved into it, and I haven't gotten any advice from high priced lawyers who've examined the contract, but just sort of shooting from the cuff, doesn't it seem to you that you're entitled to some kind of written assurance stemming from General Motors to Hughes Aircraft that they will remain the captain of their ship for the duration of this contract? And that they will remain in decisionmaking charge of that operation, and that their assets will be protected, and their assets will not be drawn out, siphoned off, bled off, and that the decision making will remain with Hughes? Otherwise, you should make your contract with GM, it seems to me.

Now, as I say, I have not studied this matter, but it seems to me that if I were in your shoes, and half of my consortium was being absorbed by another, much larger, company, I would want to look to that company both for assurances on two counts as to half of my partnership; A, that the decisionmaking authority would remain intact, and B, that their assets would remain intact.

Mr. NICHOLS. Mr. Chairman, I haven't consulted my lawyers on that. It's only 2 weeks old—the event has occurred within the past 2 weeks. I would point out, sir, that Hughes has several thousand active contracts with the Government. And I believe somewhere in the process of this transfer, assurance has already been given on this point, in terms of the commitment of the buyer to maintain an equitable approach to its responsibilities under these contracts, all of them.

Mr. SCHEUER. Good.

Mr. NICHOLS. I believe that has happened, but I haven't got the facts of my——

Mr. SCHEUER. That's very reassuring. Would you get copies of whatever documentation exists on that regard to this subcommittee, please?

Mr. NICHOLS. I shall certainly try to do so.

Mr. SCHEUER. I appreciate that. Congressman Jan Meyers.

Mrs. MEYERS. Mr. Chairman, a question about— well, I'll show my ignorance. When this kind of a contract is made and Landsat is under private control, then their results are available to other countries and other private firms. They are not just responsible to the U.S. Government.

Do we have any kind of a first call, because of research and development work that we did or anything else, if there is too much competition for the product that we get from them? Do you understand my question?

Mr. CALIO. Yes. May I work it a little bit? We are plowing new ground collectively, so it's not a question of ignorance. This is the first event of this type. We're talking about a data product that's being delivered by Eosat. It's not a communication system where you're plotting links between two points.

Under the provisions of the Landsat bill that was provided—that was put forward by this committee, we've agreed to nondiscrimina-

tory distribution of data. That says that we will sell the data product to anyone at a nondiscriminating price based on their request. That's part of our policy here in the United States. And that we will also abide by open skies, and by that meaning we have the right to assist foreign countries with our satellites.

So, the answer to your question is yes, we will sell data—or Eosat will sell data on a nondiscriminatory basis to all potential buyers as a result of the law and as a result of our policies.

Mrs. MEYERS. Absolutely first come first served, or those who—

Mr. CALIO. Best that I can—as a matter of fact, that was a point of contention because there were notions back 3 or 4 years ago that this could be a private venture, say, for oil and gas for the United States, where all the money could be put up for the satellite by that company and they would have exclusive right to that data. That would have been in violation to a policy then that the United States was carrying out, but now to a law that we will have nondiscriminatory use of that data and distribution of that data.

Mrs. MEYERS. Thank you.

Mr. SCHEUER. While I have you both here, I am going to ask the GAO to get in touch with you and to get in touch with Mr. Williams, and have a formal look at whatever arrangements are being made in contemplation of the fact that Hughes is being purchased by GM, to make sure that the interests of the Government are being solidly protected in writing.

As Sam Goldwyn once said, it ain't worth—an oral contract ain't worth the paper it's written on. And I think we would all want the taxpayer's interest to be properly protected in writing for this significant change that's only in the making right now.

Mr. CALIO. Yes, sir.

Mr. SCHEUER. Do any of my colleagues have any further questions for Mr. Calio? Since you're going to finish up with Mr. Calio, and since as cochairman you're going to chair the second half of the hearing, why don't I simply turn the Chair over to you now?

Mr. NELSON. OK.

Mr. SCHEUER. And I'll come back and I'll sub for you, and then when you have to leave, I'll take over for a few minutes.

Mr. NELSON. Tony, how much does it cost annually to operate the existing Landsat system?

Mr. CALIO. \$36 million.

Mr. NELSON. All right. When Eosat assume—when will they assume—

Mr. CALIO. As soon as they sign the contract.

Mr. NELSON. When will they assume control of the Landsat operations?

Mr. CALIO. As soon as they sign the contract.

Mr. NELSON. Now, I'm just walking you through a series of questions here.

Mr. CALIO. I've been advised that October 1 is when they will take over the operations of Landsat 4 and 5, assuming we sign the contract and—they're talking about 3 months training of bringing in the new—or getting Eosat up to speed on that.

Mr. NELSON. Now, in addition to the \$250 plus \$45 million agreement, will Eosat receive from NOAA's budget the Landsat operat-

ing cost of \$30 million for fiscal year—for the remainder of 1985 and 1986?

Mr. CALIO. Since we're taking over October 1, I guess it's fiscal year 1986—

Mr. NELSON. So it would be 1986.

Mr. CALIO. No, they don't get \$30 million for 1986, they get about \$13 million of it. The rest of it is provided to NASA for the support of the communications links—\$6 million—and \$1 million goes to NASA for the use of their building 28 where the Landsat operations station is, for photographic taps and the like to NASA and \$3 million to the EROS data center, Sioux Falls, SD, the archiving and the current distribution center gets \$6 million, and NOAA \$2. So they would receive \$13 of the \$30 million in fiscal year 1986.

Mr. NELSON. OK. There still would be the \$30 million forthcoming.

Mr. CALIO. Well, our request in 1986, and I think so far it looks like it's there, on the part of the Congress was \$30.6 million. And that would be the distribution; \$13 would go to Eosat then.

Mr. NELSON. All right. Now, when Landsat-5 fails, what happens to the operating cost?

Mr. CALIO. Go to zero.

Mr. NELSON. All right.

Mr. CALIO. 4 and 5, I assume you meant by that.

Mr. NELSON. Right. And that—it stays at zero even when you're into Landsat 6 and 7?

Mr. CALIO. That's correct.

Mr. NELSON. Any further questions? OK, thank you, Tony. We appreciate it very much. Let's call up Mr. Williams. Mr. Williams is president of the Earth Observation Satellite Co., Eosat. Please proceed. And if you'll—we have your text, it will be a part of the record, and if you'd summarize.

STATEMENT OF CHARLES P. WILLIAMS, PRESIDENT AND CHIEF OPERATING OFFICER, EARTH OBSERVATION SATELLITE CO.

Mr. WILLIAMS. Thank you, Mr. Chairman. I'd like to just read a few comments relative to the statement, and as you've said before, many of the details have been covered in the other presentations. I don't think that we need to review those.

But I am pleased to be here to testify on behalf of Eosat and on behalf of the remote sensing industry. My statement deals with two primary issues related to the Public Law 98-365. It was overwhelmingly passed by Congress, and we've delivered what we believe is a mandate for commercialization and its resultant implementation.

The remarks today, I think, relate to two issues. There are obviously a number of issues in commercialization, but the two that we feel are of most importance are the immediate program implementation, and the related issue of the potential erosion of U.S. leadership in remote sensing.

The contract procurement process has been, as has been stated before, a long and very exhausting one. Eosat, as you're well aware, has as parent corporations Hughes Aircraft Co. and RCA Corp. They've expended a number of years and many millions of

dollars getting to this point in the selection process, and are still firmly committed to the administration initiative.

We believe that the proposed contract represents what we consider the best deal for the U.S. Government and the U.S. taxpayer. I believe over the last period of time we've spent approximately 9 months in negotiation with the Department of Commerce, both the transition and the commercialization team. We've gone through a number of structured contracts, a number of elements, and we have structured what we believe mutually to be the best deal for the Government, the taxpayer, but also a challenging opportunity for Eosat.

The proposed contract does meet the intent of the RFP, it does meet the intent of Public Law 98-365, and the publicly stated initiatives of the administration relative to space commercialization.

Just briefly, the plan for commercialization, as proposed by Eosat embodies a 10-year program, the transition and operation of the Landsat-5 system that was just discussed, the development, construction, test, and launch support of two new satellites. And to emphasize again, these satellites do have a 5-year design life.

The development of a new ground system capability, which must embody the requirements for augmentation of the current system, and also embody the new technical requirements to operate Landsat 6 and 7. The upgrading of the thematic mapper, which has been discussed by Dr. Calio, not only to provide the basic 15-meter panchromatic band, but we believe it's an absolute necessity as an initial implementation and an initial step to improve the competitiveness of the U.S. instrumentation.

The development and implementation, as has been discussed, of an international marketing and sales organization which is dedicated to remote sensing. And again, it's on an international scale and it does deal with literally the full range of countries from the free world.

The resources required to address this program are very complex and comprehensive. And we believe that the expertise, as has been brought to bear by Eosat's team, again addresses the commercialization initiative and is structured to accomplish these considerable tasks.

As a minor review, Hughes Aircraft Corp., Santa Barbara Research Center, is the sensor manufacturer and one of the Eosat partners, and the other partner, as has been discussed, is RCA Corp.'s Astro-Electronics Division, who is a spacecraft designer and builder. And as stated, they are jointly and separately liable for the activities of Eosat as a joint venture.

Besides these 2 principal partners, we will also utilize Computer Sciences Corp. and Earth Satellite Corp. to complete the skill and experience mix or inventory that is absolutely essential to provide the correct credibility and commercial success that we believe can come from this venture.

There is little question that the ultimate success of this enterprise is critically coupled to the efficiency with which the market for data sales is developed, and also the continuity or the provision of data, the continual provision of data, to the end-item users throughout the world. Toward that end, Eosat has planned an aggressive long-range marketing plan with a major commitment of

human and financial resources. Those human resources come from a variety of companies, but are primarily sponsored by RCA, Hughes, and Earth Satellite Corp.

We believe that the background and the proven experience of the four major subcontractors that we deal with in this case will provide adequate technology and capability to deal with the hardware, operations, marketing, and in instrument development risks that are inherent in this type of a new venture.

We believe that we can manage these risks, and we believe that we can create a commercially viable industry which will support itself and not be dependent upon out year financing or subsidization from the U.S. Government.

Despite the unplanned delays in implementing this program, we still feel that time is a critical factor. It's crucial due to the approaching launch date of the heavily subsidized French and Japanese systems. The first of these will be the October 1985 launch of the—planned launch, I guess is more appropriate—of the French Spot Image system. This is following an intensive 2-year marketing build-up which the Spot Image people have conducted on a worldwide basis.

We believe it's critically important that the United States retain their world leadership in remote sensing and its related technologies, and not become dependent upon foreign satellite systems for research and development data. To this end, the U.S. system, we believe, must be implemented within this fiscal year in order to retain that position and try and enhance our position in the out years as a world leader in remote sensing.

The Eosat team has provided and will continue to provide 100 percent support to the administration's commercialization team. We, along with our team members, are dedicated to maintaining this U.S. leadership, and will do everything within our power to maintain the technological and industrial leadership that's necessary in remote sensing.

I think that concludes my prepared statement. I thank you for your attention and I'll be happy to answer questions.

[The prepared statement of Mr. Williams follows:]

STATEMENT OF

CHARLES P. WILLIAMS

PRESIDENT AND CHIEF OPERATING OFFICER

EARTH OBSERVATION SATELLITE COMPANY

13 JUNE 1985

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT

and the

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

of the

COMMITTEE ON SCIENCE AND TECHNOLOGY ,

U. S. HOUSE OF REPRESENTATIVES

Mr. Chairman and Members of the Subcommittee,

My name is C. P. Williams. I am President of Earth Observation Satellite Company, also known as "EOSAT".

I am pleased to be here today to testify on behalf of EOSAT and the Remote Sensing Industry. My statement deals with the Land Remote Sensing Commercialization effort by the Department of Commerce on behalf of the Administration. Public Law 98-365 was overwhelmingly passed by Congress in August of 1984 and delivered, we believe a mandate for commercialization and its resultant implementation.

There have been many presentations and briefings before Congress recently explicitly detailing Landsat and the proposed commercialization from both the Government and the industry points of view. Therefore, I will limit my remarks to the outline of the program and the pertinent issues, which we regard as: (1) the importance of immediate program implementation and (2) the potential erosion of U.S. leadership in Remote Sensing.

The Government procurement process for selection of a contractor and award of a contract for commercialization has been a long and very exhausting one. EOSAT along with its parent corporations, Hughes Aircraft and RCA, have expended a number of years and many millions of dollars in getting to this point in the selection process, and are firmly committed to the Administration's initiative.

We believe that the proposed contract represents a "best deal" for the U.S. Government and the U.S. Taxpayer and also a challenging opportunity for EOSAT. The proposed contract meets the "intent" of the RFP, Public Law 98-365 and the publicly stated initiatives of the Administration relative to Space Commercialization.

The plan for commercialization as proposed by EOSAT embodies:

- o A ten (10) year program.
- o Operation of the Landsat 5 System.
- o Development, construction, test and launch support of two new satellites, each with a five (5) year design life.
- o Development of a new ground system capability.
- o Operation of the Landsat 6 and 7 systems.
- o Upgrading of Thematic Mapper Instruments to include a 15 meter panchromatic band and improve the competitiveness of U.S. instrumentation.
- o Development and implementation of an international marketing and sales organization dedicated to Remote Sensing.

The resources required to address and implement this program are complex and comprehensive. They require investment commitments, broad technical expertise and demonstrable background in sensor technology, spacecraft design, software design, ground system operational experience, and knowledge of market development on an international scale.

EOSAT's team has been structured specifically to address the Commercialization Initiative and accomplish these considerable tasks. Hughes Aircraft Corporation's Santa Barbara Research Center is the sensor manufacturer and one EOSAT partner, and the other partner, RCA Corporation's Astro-Electronics Division, is the spacecraft designer and builder. Besides these two principal partners of EOSAT, we will utilize Computer Science Corporation and Earth Satellite Corporation to complete the skill and experience inventory essential to credibility and commercial success.

There is little question that the ultimate success of this enterprise is critically coupled to the efficiency with which the market for data sales is developed and the continuity of that data to the end-item users. Toward that end EOSAT has planned an aggressive long-range marketing plan with a commitment of human and financial resources.

We believe that with the background and proven experience of our major subcontractors in hardware, operations, marketing, and instrument development we can manage the risks normal to this type of new venture, and create a commercially viable industry which is not dependent upon continued Government support or financing.

Despite the unplanned delays in implementing this program, time is still a crucial factor due to the approaching launch dates of the heavily subsidized Japanese and French systems. The first of these will be an October 1985 launch of the French "SPOT IMAGE" system following an intensive two (2) year marketing buildup.

We believe it is critically important that the United States retain World Leadership in Remote Sensing and related technology, and not become dependent upon Foreign satellite systems for research and exploration data. To this end the U.S. System must be implemented within this fiscal year.

The EOSAT team has provided and will continue to provide 100% support to the Administration's Commercialization and Transition team. We, along with our team members, are dedicated to maintaining U.S. leadership in remote sensing.

This concludes my prepared statement.

Thank you for your attention.

Mr. NELSON. I might say that a lot of members of this committee would state the same thing that you did in your last paragraph, about the need to keep that kind of technology and data coming from American hands. And that's in large part why we are moving, and it will be successful, in the supplemental appropriations in fiscal year 1985.

Now, do you want to follow on to the question I asked you earlier about new technology?

Mr. WILLIAMS. Well, let me try to assimilate the answer to it. The plan that Eosat has at the present time, as Dr. Calio stated, was to implement a 15-meter pachromatic band as the initial technical advancement in the Landsat-6 instrument.

We also have plans, as dictated by the market, to attempt to integrate additional IR bands in the Landsat-7 instrument. That will be totally dictated by the market, and the requirements of the marketplace, and the users as far as out-year investment.

There are two satellites again, Landsat 6 and 7. Landsat-6 is scheduled for launch at the moment in December 1 1988, Landsat-7 in a following time period. But the technical advancements that are required in order to maintain a true world leadership in remote sensing do require additional technologies and additional support.

The Public Law 98-365 explicitly stated that there would be a continuance of research and development on behalf of the Government. We believe that advanced instrumentation, which can be described as a multispectral linear array type of instrumentation, is necessary in the out years in order to provide the spectral and spacial requirements, if you will, of data that are necessary to promulgate this kind of an industry.

Mr. NELSON. You said it is or is not?

Mr. WILLIAMS. It is definitely—

Mr. NELSON. It is necessary.

Mr. WILLIAMS. It is necessary. The type of resolution that we have discussed over the past year, that we have discussed in some of the design elements that have been reviewed by the Government and by different industrial firms, indicate that a 10-meter capability is probably the measure of resolution that is required in the out years in order to increase utilization by a large share of the market. That share of the market is in the renewable resource area, such as agriculture.

It has been indicated that a sizable portion of that data can be more fully utilized if the resolution is on an order of 10 meters rather than 30 meters. So, we are looking in the out years, in this kind of a program, for additional research and development being performed in the area of instrumentation.

We, on our own behalf, are cooperating with other agencies and other elements of the Government in trying to initiate some additional processing capabilities, to provide an enhanced processing capability in the out years, if you will, to try and limit the amount of—intensive requirements relative to the interface between processing data and getting it to the end-item user. Finding a better and more efficient way to provide that data directly from the satellite to the ground station to the end-item user, that's an absolute necessity if this is to be a commercial success.

Toward that end, Eosat will invest its time and its energies and its monies to try and improve the actual processing and coupling of data so that it can better process product for the end-item user.

Mr. NELSON. Will there be any technology that will be offered through the French Spot system that we will not have?

Mr. WILLIAMS. In part, yes. As I understand the French Spot system, it does have a partial stereoscopic or sweep capability. The French system will fly two sensors on a side-by-side mode, they will provide a 20-meter color and a 10-meter black-and-white resolution capability. The quality of the data has not been defined, obviously, because the system has not flown yet. That is to be proven. But by the same token, they are flying higher resolution data and they are flying a dual instrument capability, which we in the United States have not been able to do to this point in time.

Mr. NELSON. Well, is that something that we need to do?

Mr. WILLIAMS. We need to address additional requirements for better instrumentation within the next 4 to 8 years in order to retain some form of leadership in the world, and to retain a competitive posture, if you will, with respect to the foreign systems.

Mr. NELSON. You said earlier that we're ultimately going to need a resolution of 10 meters.

Mr. WILLIAMS. If we want to expand and improve the market posture that we have, specifically in the area of renewable resources, yes, that's true.

Mr. NELSON. And on Landsat 6 and 7, we're going to have the resolution down to what, 15 meters did you say?

Mr. WILLIAMS. It will be a 15-meter black-and-white panchromatic capability.

Mr. NELSON. Whereas the French system—black and white can take it down to ten.

Mr. WILLIAMS. Ten, quite true.

Mr. NELSON. All right. So, if you're a user, don't you go buy from the French system instead of Eosat?

Mr. WILLIAMS. Not necessarily. The quality of the end-item product dictates exactly which data you may or may not purchase. The fact that it is 10 meters rather than 15 meters doesn't necessarily dictate the quality of the end-item product.

There is another minor situation relative to the French. The French system takes, or has a scene capability—the actual parameters or size of the scene is 60 kilometers by 60 kilometers. So, for the purposes of geology, if you want a spot scene taken at one point in time, you might want a 10 meter black and white from this French system.

The Landsat system, by the same token, has a scene size of 185 by 100 kilometers. It has a synoptic view, a wide ranging view, which is more appropriately utilized by the majority of the users in the industry today. Geologists, in particular, occasionally like spot scenes. But the quality of the end-item data after it's processed will dictate who will capture a larger percentage of some of the user market.

Mr. NELSON. Since you say that we need to go down to ten-meter resolution, did you consider refining it so that that capability would be on Landsat-7, since you're not going to have it on 6?

Mr. WILLIAMS. As part of our original program, back in March of 1984, we had planned on implementing a multispectral linear array with a 10-meter capability. But because of the budget process and the reduction of the—or the imposition, rather, of the funding limitation by the Government—it literally required us to financially restructure and technically restructure the total program.

It's the investment itself in the out-year construction of the multispectral linear array that is, from our point of view, too large an investment for any commercial firm to make on their own behalf. It does require support in the area of research and development by the Government.

We have anticipated over the long term that if the revenue profile that we have mutually agreed upon with the Department of Commerce is achieved, that some form of instrumentation can be improved, but unfortunately that would be at the end of this 10-year program timeframe. And the timing is very poor with respect to the implementation of the French and Japanese systems. They will be flying in the 1988 to 1992 timeframe.

The only way that we could achieve commercially advanced instrumentation at an early period in time is to actually run at a revenue level which exceeds probably 125 percent of the current level.

Mr. NELSON. Well, I would sort of rhetorically ask the question here, from our standpoint maybe it behooves us to press this NASA research and development to keep us going in this area, but I'm concerned about how we get that out and have it marketed, and so forth, since Landsat 6 and 7 are already—the dye is cast, and you're operating on this 10-year cycle.

Mr. WILLIAMS. Well, I don't believe the dye is cast for Landsat-7 at all. As far as Landsat-6 is concerned, there is a fixed development cycle. And the intent of Eosat, and I believe the Department of Commerce also, is to be able to launch the initial satellite as soon as possible. And that's to reduce the hiatus between the demise of Landsat-5 and the launch of Landsat-6.

Mr. NELSON. So the question is still an open question for Landsat-7.

Mr. WILLIAMS. I believe it is, yes.

Mr. NELSON. Do you think that's right, Dr. Calio?

Mr. CALIO. Yes, sir.

Mr. NELSON. OK. Then that's something we need to continue to have visitation on, as to what's in the best interest of the country with regard to the technology on Landsat-7.

All right, let me ask you this. How do you plan to interact with foreign ground stations?

Mr. WILLIAMS. Our agreement with the Department of Commerce transition team is that we'll accept the existing memorandums of understanding, as negotiated by the Department of Commerce, with the foreign ground station. Those memorandums currently exist and describe the operation of the processing or receipt of data from Landsat-5.

We have agreed also, and the Department of Commerce has made it part of our contract, that NOAA will retain oversight and management responsibility for all foreign affairs, all foreign ground stations. The foreign affairs portion of it relates to the fact

that the majority of the foreign ground stations are either Government agencies or are owned by the Government, financed by the Government. And toward that end, they would rather interface with a Government agency as the management responsibility.

We have agreed mutually that NOAA should retain that management and oversight responsibility.

Mr. NELSON. What do you plan to do when those MOU's run out?

Mr. WILLIAMS. At the end or at the demise of Landsat-5 we would—we, in concert with the Department of Commerce, would negotiate a new memorandum of understanding with each of the individual ground stations in their particular geographic or area of interest. But it would require a new memorandum of understanding, and it would include the Department of Commerce, and I believe on the last one that was signed it included the Department of Treasury. And I believe Donald Regan was on the last one.

Mr. NELSON. Are you going to market through those ground stations?

Mr. WILLIAMS. Yes. The intent is an interactive coupling with the ground stations. They have the right to market the product in their own area. But by the same token, we will buy some product from them in their particular area of interest, and we will also attempt to market product through them. So, we will buy and sell on an interactive basis.

Mr. NELSON. Mr. Brown?

Mr. BROWN. Thank you, Mr. Chairman. You make reference to the fact that you have a marketing plan, or you're developing it, you're working on it. This has always fascinated me. Is it possible that you could provide the committee with an outline of your marketing plan that wouldn't reveal any commercial secrets that would be deleterious to you?

Mr. WILLIAMS. You mean at this point in time or in a written form?

Mr. BROWN. In a written form.

Mr. WILLIAMS. Yes, we'd be happy to do that.

Mr. BROWN. Yes. I'm interested in—right now your main market is Government agencies, as I understand it. The majority of the revenue is coming from Government agencies that have a use for the Landsat data?

Mr. WILLIAMS. No, sir. The percentage of data purchased by the Federal agencies is approximately 25 percent.

Mr. BROWN. Only 25 percent. I thought it was a little more than that. I would like to know what market sectors you're looking at—obviously the oil industry, probably heavy construction, maybe agriculture. I'd like to know whether you've included State and local governments, other foreign governments, and so forth, and what you think the potential is in these areas without going into any unnecessary detail.

Mr. WILLIAMS. Yes, we can provide that for you in a very short—

Mr. BROWN. And I'm not interested in how many salesmen you're planning to put on or anything like that, but just where you see the revenues coming from, more than anything else. I think that's the interesting point from our standpoint.

Now, Mr. Calio indicated that you would be marketing unenhanced data, is that correct?

Mr. WILLIAMS. Basically, as defined by the contract, yes.

Mr. BROWN. Would you define unenhanced data for us, either now or in a written statement?

Mr. WILLIAMS. Yes. Unenhanced data is defined in Public Law 98-365. I'd be happy to give you—

Mr. BROWN. No, if it is, I'll look it up.

Mr. WILLIAMS. Minimally processed data. Our intent there is not to impede the progress or invade the rights of the value-added industry.

Mr. BROWN. That was my next question. Now, what are we doing to cooperate with, stimulate, promote the development of the value-enhanced industry in view of the fact that you're only going to be providing unenhanced data, however it's defined? Or is that a part of your—in any shape—obviously the more we can do to develop a value-added industry, the better your marketing is going to be.

Mr. WILLIAMS. Yes, that's quite true. It is our intent, and we have been interfacing over the last year directly with a number of value-added firms within the United States. And as you correctly stated, it is our understanding and intent to enhance and expand the value-added industry, because we believe that's the only way that we're going to reach a large segment of the small users.

It is not our intent to try and supplant or obviate any of the value-added companies in this country today, but try and expand the number of companies that are participating in the future or additional processing in enhancement of the data for different applications.

We feel the same way about the international market. They're a large number of value-added companies in Europe, in particular, and also in Japan, through which we can market data and reach a larger segment of the market than we could by trying to deal direct with the end-item user.

Mr. BROWN. Now, obviously you're in the role here of a wholesaler of data. Your value-added industry are your retailers, and then your ultimate customers are whoever the value-added people can bring into the network. But as with any industry, your marketing plan ought to put some emphasis on how to develop your retail network, your dealer network, most effectively.

Mr. WILLIAMS. Definitely. It does, and toward that end it would be more appropriate to provide you with a complete written outline. But it does address both the domestic portion of the market and the international portion of the market, as you indicated, from a wholesaler point of view, dealing with the value-added industry and the foreign ground stations, and from the retail point-of-view dealing directly with any area such as oil companies.

Mr. BROWN. Well, I'd be happy to see a brief written description of that. Let me ask you just one additional semitechnical question with regard to moving from, say, 15-meter to 10-meter resolution, or something like that.

Obviously this can be done by changing your orbital parameters without changing your equipment. What are your restraints with regard to orbital parameters on the satellite?

Mr. WILLIAMS. I guess I don't have a direct answer. Let me ask Warren Nichols of Hughes Aircraft to answer.

Mr. NICHOLS. Well, sir, the basic instrument we propose to use is the thematic mapper, and its design is a mechanically scanning design, as I'm sure you're aware. And as such, it is essentially orbit altitude peculiar. And so, it's not the easiest thing in the world to change orbit altitude, but—

Mr. BROWN. All right. I wasn't aware of this. I'm just exploring this.

Mr. NICHOLS. Part of our basic program design here stems, I think, from experience both at RCA and Hughes in the commercial communications satellite business. And an underlying precept, really, of the program we put together is to take existing designs, wherever possible, and extend them where necessary, but not just for the purpose of advancing technology or giving engineers fun things to do.

We are building on a spacecraft which has flown a number of times—basically the polar Metsat—and on an instrument which has flown twice, specifically in Landsat 4 and 5—the thematic mapper. It's on the basis of the extension of those designs that we can offer the kind of deal we do. It is not all new technology, but it is building on existing designs which have had inherent in them, for sometime, the ability to expand and to grow. We're taking that growth step in an evolutionary rather than revolutionary sense. That's the underlying business plan and technology plan we're working with here.

Mr. BROWN. Well, I understand that. My—

Mr. NICHOLS. In the orbit altitude context we don't feel particularly constrained except by some practicalities. The 16-day revisit time, which goes with that particular orbit altitude, is about the best choice we could make. We've looked at others, and it's pretty good. We've looked at both lower and higher altitudes, and our perception is that this is for a variety of technical and business reasons the right one. It avoids a lot of redesign, the cost and risk that goes with that, et cetera.

Mr. BROWN. Well, if you were an amateur photographer on earth and you had a camera and you wanted to take pictures, and you wanted a bigger picture, a better resolution picture, you either get a bigger lense or you could get closer.

Mr. NICHOLS. Yes, sir.

Mr. BROWN. And that's, you know—

Mr. NICHOLS. We have looked at alternatives such as flying thematic mapper in shuttle. If we could get to a 350-kilometer orbit altitude, as opposed to 700, we do get some of the advantages of being close, and that is technically possible.

Mr. BROWN. But it changes your revisit time.

Mr. NICHOLS. Yes, it does.

Mr. BROWN. I have no further questions.

Mr. NELSON. For the record, let's get this answer. Do you foresee any problems in operating this remote sensing business in conformance with last year's public law?

Mr. WILLIAMS. No, we don't. The proposed contract does meet the intent and has been structured to meet the requirements of the public law.

Mr. NELSON. All right. What ways will your marketing efforts be an improvement over the current marketing efforts?

Mr. WILLIAMS. That's a large question.

Mr. NELSON. I want you to be specific.

Mr. WILLIAMS. Yes.

Mr. NELSON. Services, inventory, delivery, et cetera.

Mr. WILLIAMS. At the present time, the Government does not have a marketing organization that's dedicated to providing data to the end-item user. A number of the agencies, both through the Department of Commerce and the Department of Interior, interface with potential users in the domestic area. There is no direct relationship or interface, if you will, with foreign users. It's on a totally indirect basis relative to the foreign community.

It is Eosat's current plan and posture to provide an international marketing organization which will utilize, as a basis, some of the marketing talents and organization of RCA and of Hughes Aircraft. At present that amounts to some 223 potential business organizations throughout the world. It is an existing network, it's something that we can utilize to the fullest extent that we can relative to remote sensing.

There is also a net that we have agreed that we're going to try and implement. Part of the information and data net that we're going to implement is a system called Infonet, I-N-F-O-N-E-T. This is a system which was originally developed by The Computer Science Corp., and we look at it as a method for distributing data and information throughout the world. It has some 136 interactive centers throughout the world from which data can be either ordered or processed.

The intent, as far as we're concerned, relative to the domestic users, which we feel is the biggest portion of our current market, is to try and supply data through a number of existing organizations. It is our intent to maintain EROS as their processing capability and processing center for data, as a minimum, for 24 months—100 percent of their current operation. They distribute data through the U.S. cartographic centers.

It is also our intent that as long as EROS is maintained in that posture, they will continue to process data and distribute data through the cartographic centers. At the same time, Eosat will be bringing up an augmented processing and distribution capability. And then there will be a transition period which will probably be on the order of 6 months, during which we'll be utilizing both systems until we actually transition to the Eosat distribution center or distribution technique, if you will, in toto.

The intent is multifold. One, in bringing up an augmented capability, it's to support primarily the marketing and distribution of the data to the end-item user. Toward that end we want to achieve a faster turnaround time with improved man-machine techniques and processing techniques to try and reduce the amount of time that it takes to get the data from the spacecraft to the end-item user. That, in itself, is a large problem in the present day system. The original system was a research-and-development type system, and we would like to transition that to our production mode. So, reduction of the through-put time is a critical factor. Improvement of the product is the second critical factor.

The other thing that supports that overall marketing emphasis, as has been stated earlier, is to provide a capability for fractional scenes. The one discussed this morning was a quarter scene. The augmented processing capability will allow the processing of a partial scene, and related to that will be a scene reduction, or a price reduction to the end-item user.

Mr. NELSON. What about the regional net? Is it in Africa?

Mr. WILLIAMS. I'm sorry. I don't understand the reference to the question.

Mr. NELSON. Regional centers in Africa.

Mr. WILLIAMS. Oh, the regional remote-sensing centers?

Mr. NELSON. Yes, please.

Mr. WILLIAMS. In reality, a regional remote-sensing center is a term which is applied to the remote-sensing centers throughout the world, not just in Africa. In the United Kingdom it's referred to as the national remote-sensing center, but in other elements it is defined as a regional, even though it is supported by the Government in almost every case. So, it is truly a national remote-sensing center, both in the Union of South Africa, in Australia, Thailand, India, also in the United Kingdom which is part of the European Space Agency network, the ESA network.

Mr. NELSON. Are you going to utilize that as a marketing channel? That's what we want to know.

Mr. WILLIAMS. The answer is yes, definitely.

Mr. NELSON. Now, what do you see is the major risk to successful commercialization of land remote-sensing?

Mr. WILLIAMS. Well, I think right now there are a couple of minor issues that are on the table between the Department of Commerce and between Eosat. One of those issues has to deal with changes in international law, initiatives that are proposed by the United Nations which may obviate some of the rights of Eosat in marketing remote-sensing data, or in a few cases, areas of change in law with respect to national rights or sensing of data or sensing of the terrain over a specific country.

Those are issues that cannot be managed or defined at this point in time. Those are things that may occur later in time, as we had indicated earlier by changes in foreign policy or changes of policy within the particular countries, or by U.N. initiatives. In that particular case, those are areas that would effect directly the capability of Eosat, not only to acquire data, but to process and or sell data within that particular area.

I think the other major risk that we have to address in this type of a venture is the initiation of the venture overall. Dr. Calio referred to it as the signing of the contract, and that's as appropriate as anything else. The problem that relates to that is the hiatus between the demise of Landsat-5 and the acquiring of data from Landsat-6. That time period is an undefined period due to the fact that no one can forecast the explicit design life of Landsat-5. Every day that it flies, the probability that it will fly longer goes up.

But by the same token, there still will be a hiatus, meaning that there will be a period during which we cannot acquire active satellite data. And during that period of time, we will be selling data from the commercial archive or acquiring data from a foreign

system and processing it on our own to sell to our end-item users and our customers.

The third risk might have to do with unusual events or catastrophic failures. To the commercial venture, a catastrophic failure would be the complete loss of the satellite, during at which time we would have to bring another satellite up in a very short order. A catastrophic failure now would be a complete loss of Landsat-5.

Mr. NELSON. What level of profitability will Eosat require to build and launch follow-on satellites?

Mr. WILLIAMS. Follow-on satellites? This would have to be an opinion, my own personal opinion, but I would believe that we would have to operate at something between 110 to 125 percent of the projected revenue curve over the full 10 years in order to finance additional satellites.

Mr. NELSON. Totally from your operation, excluding any Government involvement.

Mr. WILLIAMS. That's right.

Mr. NELSON. 110 to 125 percent—

Mr. WILLIAMS. Of the current projected revenue over the total time period.

Mr. NELSON. All right. And will you supply us for the record, so that we understand that question, your projected revenue over those 10 years?

Mr. WILLIAMS. Yes, we will.

[Material referred to follows:]

EOSAT PROJECTED REVENUES (\$M)

	<u>CY85</u>	<u>CY86</u>	<u>CY87</u>	<u>CY88</u>	<u>CY89</u>	<u>CY90</u>
Data Sales	3,200	24,980	18,800	13,200	45,059	55,680
L5 OPNS	2,828	13,271	3,144	-----	-----	-----
FFP Hardware	37,140	64,917	84,259	47,839	15,845	-----
	-----	-----	-----	-----	-----	-----
TOTAL:	\$43,168	\$103,168	\$106,203	\$61,039	\$60,904	\$55,680

EOSAT PROJECTED COST OF SALES (M)

L5 OPNS	2,800	13,116	3,047	-----	-----	-----
Hardware	37,140	64,917	84,259	47,839	15,845	-----
EOSAT/Misc	3,800	11,237	18,406	23,126	32,436	33,662
	-----	-----	-----	-----	-----	-----
TOTAL	\$43,740	\$89,270	\$105,712	\$70,965	\$48,281	\$33,662
Pre-tax Income	<\$ 572>	\$13,898	\$ 491	<\$9,926>	\$12,623	\$22,018

EOSAT PROJECTED REVENUES (\$M) CONTINUED

	<u>CY91</u>	<u>CY92</u>	<u>CY93</u>	<u>CY94</u>
	58,026	66,900	70,230	37,220
	-----	-----	-----	-----
	-----	-----	-----	-----
	-----	-----	-----	-----
TOTAL	\$58,026	\$66,900	\$70,230	\$37,220

EOSAT PROJECTED COST OF SALES (\$M)

	-----	-----	-----	-----
	-----	-----	-----	-----
	\$33,494	\$35,399	\$37,180	\$19,105
	-----	-----	-----	-----
TOTAL	\$33,494	\$35,399	\$37,180	\$19,105
Pre-tax Income	\$24,532	\$31,501	\$33,050	\$15,385

Mr. NELSON. And that will be made a part of the record. Now, do you expect to develop any new products?

Mr. WILLIAMS. As a matter of pure research and development? There is product development that has been pursued for quite a period of time at Santa Barbara Research Center for the sensors, and there's some product development related to the design of the basic spacecraft bus, which is going on at RCA Astro-Electronics. But as far as a complete instrument development, we need to define product. If that means complete instrument, no, we are not in the process nor do we have the capability at present to run a complete R&D capability on an advanced instrument. It's a large venture.

Mr. NICHOLS. May I add to that comment?

Mr. NELSON. Yes, quickly, because I'm going to have to go vote.

Mr. NICHOLS. All right. First of all, I think that the issue of products has to do with data products primarily, and we will be adding data products. First of all, the 15-meter data is new product. We are going to be doing market studies to see if we can make a reasonable cost-effective trade on adding additional bands in the long wave IR. And we'll do that primarily in the context of Landsat-7. We think that that is a good trade, but we're going to confirm it with market studies.

We expect to open up, particularly as we get new processing capability on line, the ability to make product in different formats; floppy disks to serve the small computer, image processing industry, that we think is going to grow, possibly optical disks for the large boys that didn't want to buy full scene imagery in a more compact or more modern format than the multitape formats that we're now using. We'll be working very closely across the industry and with the value-added people to come up with new and cost-effective data formats.

May I add one further comment, sir?

Mr. NELSON. Sure.

Mr. NICHOLS. I would like to return to the 10-meter issue for a half a moment, and add a little bit to what Mr. Williams said. We have a contract in final draft form at this point in time with the Department of Commerce covering a 10-year period, the procurement of two satellites, and the conduct of the business of what amounts to a 10-year market test, and with a very serious objective of developing the market to the point where it can be a fully commercial effort.

We stand by that deal. The issue of 10 meters, which Mr. Williams raised, was in response, I believe, to your question about bringing further new technology to the business. And we feel strongly that the next generation instruments will ultimately have to be stepped up to and provided. But we do not, in saying that, have any intention of modifying the basic deal that we now have, essentially ready to execute, with the Department of Commerce. The cap stands as far as we're concerned.

Mr. NELSON. The what does?

Mr. NICHOLS. The cap that has been negotiated by the administration stands.

Mr. NELSON. All right. Do you have anything to add, Mr. Williams?

Mr. WILLIAMS. No, I don't believe so. Thank you.

Mr. NELSON. Mr. Calio?

Mr. CALIO. I agree with that. I'm glad Mr. Nichols said it, or I'd have to say it.

Mr. NELSON. All right. Mr. Calio, Mr. Williams, Mr. Nichols, thank you all. The meeting is adjourned.

[Whereupon, the hearing was adjourned at 4:35 p.m.]

APPENDIX

U.S. Department of Commerce
 National Oceanic and Atmospheric
 Administration
 National Environmental Satellite,
 Data and Information Service
 Washington, D.C. 20230

SUMMARY OF EOSAT CONTRACT

The Commerce Department's contract with Earth Observation Satellite Company (EOSAT), a joint venture partnership of RCA and Hughes Aircraft Corporation, combines the requirements specified in both Title II and Title III of the Land Remote-Sensing Commercialization Act of 1984 into one complete program. For a fixed price of \$250 million, EOSAT will (1) design, build, and deliver two satellites (LANDSATs 6 and 7) and a ground station capable of operating them, (2) operate and process data from LANDSATs 4, 5, 6 and 7; and (3) conduct a world-wide marketing program for LANDSAT data.

Specifically, EOSAT is to:

- o Operate LANDSATs 4 and 5 for their anticipated lifetime at a cost to the government similar to the Government's projected cost.
- o Market LANDSATs 1 thru 5 data at EOSAT's expense.
- o Provide a ground system to operate LANDSATs 6 and 7 and process data from these spacecraft. The ground system is to be completed prior to the launch of LANDSAT 6. This ground system is to be significantly more efficient than the present ground system.
- o Operate and maintain this ground system at EOSAT's expense. EOSAT may improve the ground system at its own expense.
- o Design, develop, construct, integrate and provide launch support for LANDSATs 6 and 7
- o Satellite hardware will continue present capabilities with improvements:
 - the new satellites will contain thematic mappers substantially identical to LANDSATs 4 and 5,
 - a new black and white band with ground resolution improved from 30 to 15 meters will be added,
 - a new onboard processor will be provided to allow

thematic mapper data to be aggregated at a larger scale - thus lowering data rates and giving synoptic coverage and new band options for agriculture.

- the design lifetime will be five years of on orbit operation.
- Landsat 6 is scheduled for launch in December of 1988. Landsat 7 will be launched when Landsat 6 nears the end of its lifetime. These launches will be provided by the Government as will any modifications to either satellite necessary for the Space Transportation System (STS) at a total cost quoted by NASA to be \$44.9 million.
- o Operate and maintain all aspects of the LANDSATS 6 and 7 systems at EOSAT's expense.
- o Market the data from LANDSATS 6 and 7 at EOSAT's expense.
- o Provide various items of technical and administrative data

The contract includes some special contract requirements. The principal ones are described below:

- o The contract will be funded on an incremental basis consistent with the availability of annual appropriations, with the termination liability of the Government to EOSAT limited to these amounts.

Fiscal Year

1985,6	90,000,000
1987	87,000,000
1988	55,000,000
1989	18,000,000

Total Funding 250,000,000

- o The contract provides for EOSAT to receive provisional payments from the Government concurrently with its expenditures.
- o EOSAT will be required to fulfill the United States Government's existing obligations under its memoranda of understanding with foreign ground stations. EOSAT will receive a pro-rata share of these foreign ground station revenues.
- o EOSAT's responsibility to market LANDSAT data and operate LANDSATS 6 and 7 is limited by its receipt of revenue. Specifically:

- EOSAT may terminate data marketing for LANDSATs 4 and 5 if cumulative revenue is below 65 percent of the mutually agreed upon projected revenues for data sales from these two satellites.
 - EOSAT may terminate operations and data marketing for LANDSATs 6 and/or 7 if total cumulative revenue fall below 60 percent of total projective revenue after launch of LANDSAT 6.
 - Even if this clause is invoked, EOSAT will deliver LANDSATs 6 and 7 and the ground station.
 - EOSAT may not terminate LANDSATs 4 and 5 operations under this clause.
- o The Government archive gets LANDSAT 4 and 5 data and LANDSAT 6 and 7 data from the commercial inventory for the cost of reproduction and transmission.
 - o EOSAT's right to receive revenue from data sales and EOSAT's rights to restrict reproduction and distribution of data it markets are set forth in detail.
 - o EOSAT will comply with all National Security Requirements.

EARTH OBSERVATION SATELLITE COMPANY

1901 N. MOORE STREET
ARLINGTON, VIRGINIA, USA 22209



April 11, 1985

The Honorable Malcolm Baldrige
Secretary
U. S. Department of Commerce
Herbert C. Hoover Building, Room 5851
Washington, D. C. 20233

Dear Mr. Secretary:

Implementation of the President's commercialization initiative and the legislation overwhelmingly passed by the Congress in 1984 is critical to maintaining U.S. leadership in space, and preventing the transfer to technological assets developed in this country to Japan and France.

The establishment of a commercially viable land remote sensing program is highly challenging, but achievable, with the initial support of the U.S. Government and the continuing resources and investment of private industry. It has been estimated that the Government capital investment of \$250 million, along with the EOSAT projected \$450 million in data revenue will spawn a secondary market in excess of \$5 billion over the next ten years. U.S. industry is now poised for significant growth.

U.S. economic benefits cited are heavily dependent on the continuation of the LANDSAT system. "OPEN SKIES" policy, continuity of data, key technologies and competitive pricing cannot be sustained without a U.S. LANDSAT program. Failure to proceed with LANDSAT will result in Japanese and French dominance of civil resource intelligence, with potentially unpleasant consequences for the U.S. The U.S. would not have assured access to equivalent data in the free world in times of international stress, or in times of civil emergency.

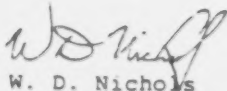
EOSAT's willingness to undertake the risks attendant to commercialization has been evidenced by the commitment of resources by RCA and Hughes, an investment of over \$10 million to date, and submission of a fixed price hardware proposal.

The Honorable Malcolm Baldrige
April 11, 1985
Page 2

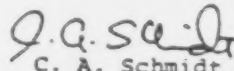
We offer the attached information in response to specific questions concerning: (1) the breadth and credibility of the data market, (2) the economic benefits of LANDSAT, and (3) the risks EOSAT assumes in the program.

Again, we would like to reinforce our commitment to the proposed program and reaffirm our support toward continuance of a U.S. civil remote sensing program.

Respectfully yours,



W. D. Nichols
Vice President - Hughes
EOSAT Executive Committee



C. A. Schmidt
Vice President - RCA
EOSAT Executive Committee

Attachment

WHY LANDSAT/EOSAT

SHOULD PROCEED:

● A LEGITIMATE U.S. NEED DOES EXIST:

THE PROPOSED \$286 M SUBSIDY WILL SUPPORT:

- CURRENT ECONOMIC ACTIVITY - \$300 MILLION/YR (1984 EST)
- FUTURE (10 YRS) GROWTH - ESTIMATED CUMULATIVE ECONOMIC ACTIVITY - \$6 BILLION + (NEARLY ALL NON-FEDERAL)
- STATED FEDERAL POLICIES:
 - OPEN SKIES, NON-DISCRIMINATORY ACCESS TO DATA
 - COMPETITIVE PRICING OF DATA
 - ASSURED ACCESS TO EQUIVALENT DATA IN TIMES OF STRESS

● THE PROPOSED PROGRAM IS FAIR TO BOTH PARTIES:

- FIXED PRICE HARDWARE COST - \$286 MILLION - LESS THAN HALF L4/L5 PROGRAM COST BUYS 2 SATELLITES, LAUNCHED, WITH INSTRUMENTS, PLUS \$36 MILLION GROUND UPGRADE
- OPERATIONS COST - PAID BY SALE OF DATA: EOSAT MARKET PROJECTIONS VERY CONSERVATIVE. (ACTUALLY LESS THAN OMB'S FOR FIRST FIVE YEARS) AT OMB PROJECTED REVENUE PROGRAM COULD CONTINUE WITHOUT FURTHER SUBSIDY THRU 10 YEARS.
- UNDER ANY CIRCUMSTANCES - A FAIR MARKET TEST WILL BE PROVIDED.

WHERE LANDSAT IS TODAY:

SUMMARY OF INVESTMENT AND BASIS FOR GROWTH

● CAPITAL INVESTMENT: (CUMULATIVE TO DATE)	
- U.S. GOVERNMENT	1,000 +
- U.S. NON-FEDERAL	180
- ALL FOREIGN	<u>300 +</u>
	1,480 MILLION
● ANNUAL OPERATIONS COSTS: ^Δ (MOST RECENT YEAR)	
- U.S. GOVERNMENT	35
- U.S. NON-FEDERAL	208
- ALL FOREIGN	<u>60</u>
	303 MILLION
● DATA SALES: (ESTIMATED 1984)	
- U.S. GOVERNMENT	9.5
- U.S. NON-FEDERAL	2.5
- ALL FOREIGN	<u>4.2</u>
	16.2 MILLION

^Δ REFERENCE: TABLE 1, ATTACHED

Q. What is the breadth and credibility of the LANDSAT data market?

- Market projections from many sources confirm EOSAT's 10 year revenue projections. (Kodak/ERIM, Earthsat, ECON, Dept. of Commerce, Terra-Mar, SPOT, etc.) (Ref. Figure 1.)
- EOSAT cumulative global estimate thru 1994 is \$940 million. EOSAT conservatively estimates its average share at 47% or \$450 million
- These projections are supported by:
 - New "Ground Rules" under Public Law 98-365 or the proposed contract:
 - * NO MORE FREE DATA (to date, the U.S. Government has given away as much as it has sold.)
 - * BETTER SERVICE (\$36 million upgrade of ground processing and \$75 million professional marketing budget.)
 - * COPYRIGHT PROTECTION (Currently users often swap tapes, reducing sales by a factor of 2 or 3.)
 - Improved Technology:
 - * LANDSAT 6/7 sensors will provide new data products: 15 meter "PAN", EMSS (including IR data), and an option for expanded thermal data.
 - * FANTASTIC GROWTH IN MICRO-COMPUTER INDUSTRY has reduced cost for sophisticated data analysis systems from \$500K to \$25K and opened the door to many more users.
 - New markets derived from recent applications development
 - * Geology: e.g. Geochemical signatures require data sets collected at different times of the year under different meteorological conditions (LANDSAT much better than SPOT)
 - * Agriculture: e.g. LANDSAT and METSAT complement each other to greatly improve worldwide crop estimates and resource costs.

- * Land use/Environment: e.g. Computer models using repetitive LANDSAT data provide inexpensive means of continual land use/management and environmental monitoring to assure proper utilization of national resources.
- Market base exists, ready for expansion.
 - * Large customer base already exists. See recent NOAA Global Data User Survey (2/85). Ref. Table 3.
 - * Over 100 value added companies: Servicing LANDSAT data users in Government and industry.
 - * Over 200 oil and mining companies: Using LANDSAT data as a major resource exploration tool.
 - * Over 1000 small to medium size exploration companies: Constituting largest potential market. Affordable technology which significantly increases exploration cost effectiveness.

Q. What are the economic benefits generated by the proposed LANDSAT/EOSAT program?

• PROJECTION: HIGHLY LEVERAGED ECONOMIC BENEFITS ACCRUE:

- * An estimated \$6.6 billion of economic activity is generated by data, computer, ground station, spacecraft, sensor and service company sales over the next ten years by the proposed subsidy. (Ref. Figure 3, Table 2)
 - Data sales - \$450 million
 - Image processing and equipment sales - \$966 million
 - Computer sales and service - \$400 million
 - Value-added sales - \$4,500 million
 - Aerospace hardware and services - \$286 million

• BASIS FOR PROJECTION:

- * A solid industry base now exists:
 - Over 100 value-added service companies
 - Over 50 U.S. manufacturing companies now producing image processing hardware/software
 - Over 50 remote sensing centers established world-wide (academic, industrial, Government)
 - An estimated 10,000 trained professionals now in the field
- * The value-added multiplier on data costs is conservatively set at 10
 - Current data (\$16 million 1984 data sales, \$305 million globally, annual recurring) suggests factor is closer to 20:1
 - Many independent studies (IBM, GEOSAT, Metrics, Terra-Mar, ERIM, for example) all suggest 10 to 20:1

- * Increased global resource pressure will provide market stimulation as many users become more dependent on remote sensing technology (and more sure of continuity)
 - Increased worldwide competition for mineral and petroleum resources will dramatically expand market for exploration services. -
 - Increased agricultural development in the third world will require quick and inexpensive information on soils and water resources.
 - Increasing pressure on land resources has resulted in rapid growth of geographic information system technology. (One company sold 100 systems alone.)
 - Environmental monitoring will be a growing worldwide activity which will require continual macro-scale information on land and water resources. (For example: techniques for identifying early damage from acid rain have been demonstrated.)
 - Multidata base resource management and information systems are being increasingly used by government and industry.

Q. What is the scope and nature of the risks EOSAT assumes in this program?

* PROGRAM DIRECT

- Commitment of key resources over 10-year period (loss of key opportunities)
- \$75 million market development program
- Competition with heavily subsidized French and Japanese systems
- Fixed price hardware program
- Loss of large program investment (to date: \$10M and three years)
- Transition from a government R&D system to a commercially viable production capability

* EXTERNAL (elements outside of EOSAT control)

- Government imposed "PUBLIC GOOD" provisions expose EOSAT to revenue risk for causes outside its control:
 - Assumption of U.S. Government obligations to service and administer foreign ground stations
 - Effective exclusion of EOSAT from the value-added business
 - Provisions which ensure "open skies" and "equal access"
 - National Security Guidelines
- National emergencies (floods, earthquakes, etc)
- National policy changes (South Africa, etc)
- U. N. initiatives (overflight, copyright, etc)
- Periods of international stress (police actions, natural disaster, etc)
- World recession and currency fluctuations

ATTACHMENTS

TABLE 1	Global Annual Manpower Expenditures
TABLE 2	Gross Sales Generated by LANDSAT
TABLE 3	Global User Data Survey
FIGURE 1	Revenue Forecasts from all sources
FIGURE 2	Projected Remote Sensing Market Potential
FIGURE 3	Gross Income Generated by LANDSAT (pie chart)
FIGURE 4	Key Components Required for LANDSAT Commercialization
FIGURE 5	Proportional Distribution of Remote Sensing Revenues With Time
CHARTS 1 & 2	Sensor Spectral Capability Provides Path for Market Growth

TABLE 1
GLOBAL
ANNUAL MANPOWER EXPENDITURES
FOR DATA COLLECTIONS AND ANALYSIS

Sector	No. of Organizations	Average No. Persons	Man-Years
U.S. 011 - Major - Smaller	20 100	15 2	300 360
State Government	50	10	500
Regional Planning	50	5	250
U.S. Value-Added A&E	250	1	250
Image Processing	10	7	70
Consulting Interpretation Co.	25	10	250
Free Lance Interpreters	300	1	300
Hardware Manufacturers	25	20	500
Federal Agencies	15	10	150
Landsat Operations			300
			3,230 x \$75,000 MY = \$242,250,000
Foreign			
National Centers	50	25	750
Ground Stations	15	10	150
Oil Companies	30	5	150
A&E	25	1	25
Hardware	25	20	500
			1,575 x \$40,000 MY = \$63,000,000

SOURCE: Earth Satellite Corp., 1985

TABLE 2:

Gross Sales Generated by Landsat
(\$6.3 Billion Over 10 Years)

- Data Sales \$450 million
- Computer Sales \$400 million
 30% of value-added costs are computer costs. Value-added costs are 10X Data Sales. New computer equipment sales are 15% of total computer costs.
 Therefore: $.15 \times .30 \times 10 \times 450 = \$200$ million
 Software for computer sales = \$200 million
- Equipment and Services \$966 million
 1. Optronics sold 104 instruments in past 10 years. Should sell at least 150 units in next 10 years at \$100K per unit.
 $150 \times \$100K = \$15$ million
 2. Photolabs - minimum capability to handle Optronics - 150 units at \$100K/unit - \$15 million
 3. Maintenance, supplies, insurance cost is \$6K per month per unit including computers, Optronics and photolabs. Total units equal 1,000 large computer, 300 equipment items. \$6 thousand $\times 1,300$ units $\times 12$ months $\times 10$ years = \$936 million + \$15 million Optronics and \$15M photolab = \$966 million
- Value-Added Sales \$4.5
 10X Data Sales of 450 million = \$4,500 million
- Space craft, sensors, ground station, and launches = \$286 million

TABLE 3

Summary of NOAA/GEOSAT Global User Data Survey
(February 1985)

- 81 Countries Participated
- Responses Were Received From:
 - * 388 Government Organizations
 - * 578 Private Sector Entities
 - * 268 Colleges/Universities
 - * 85 Other Activities

FIGURE 1

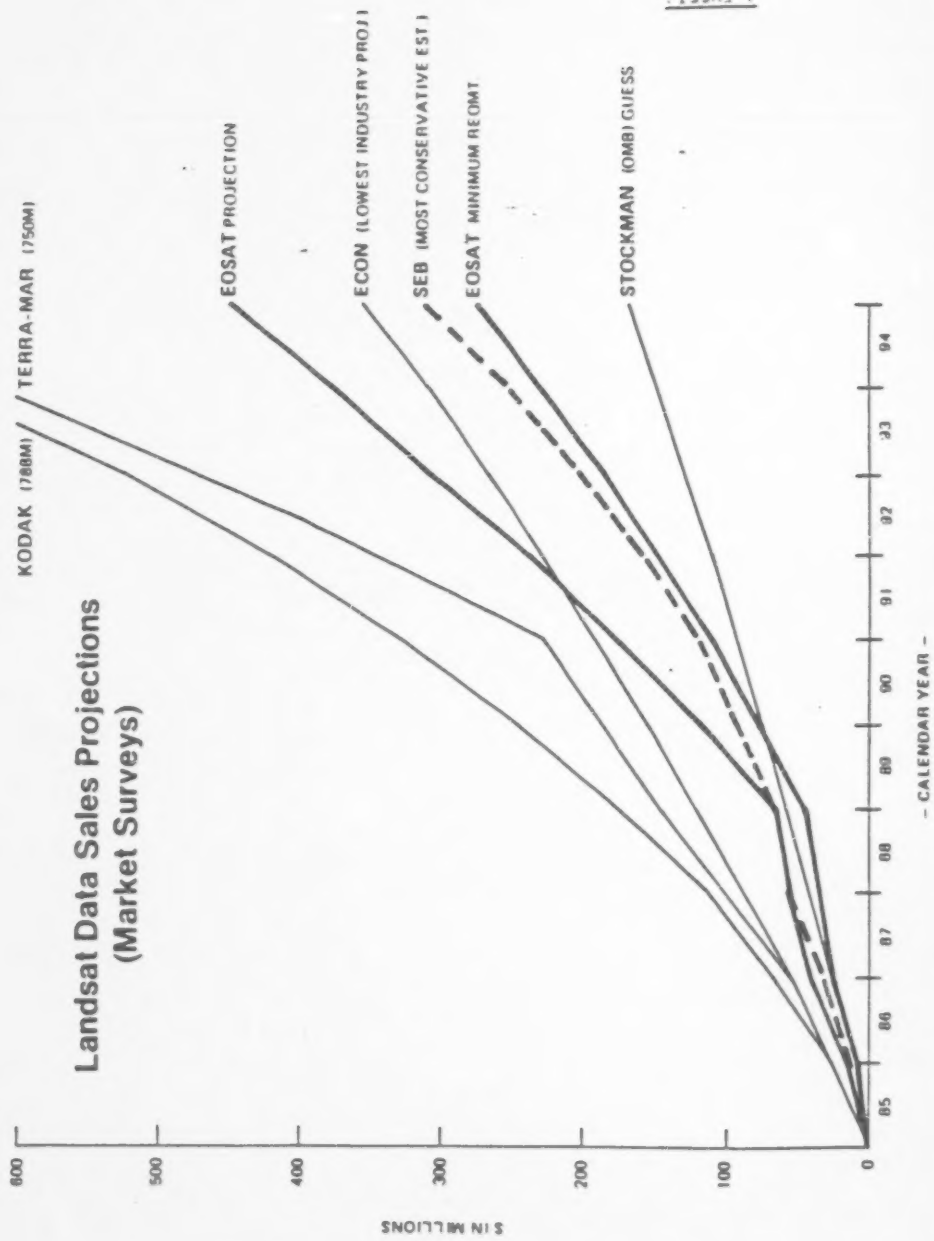
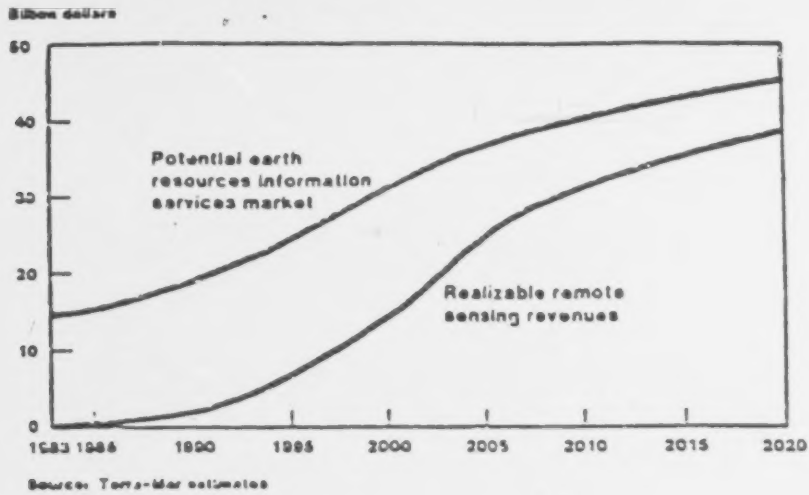
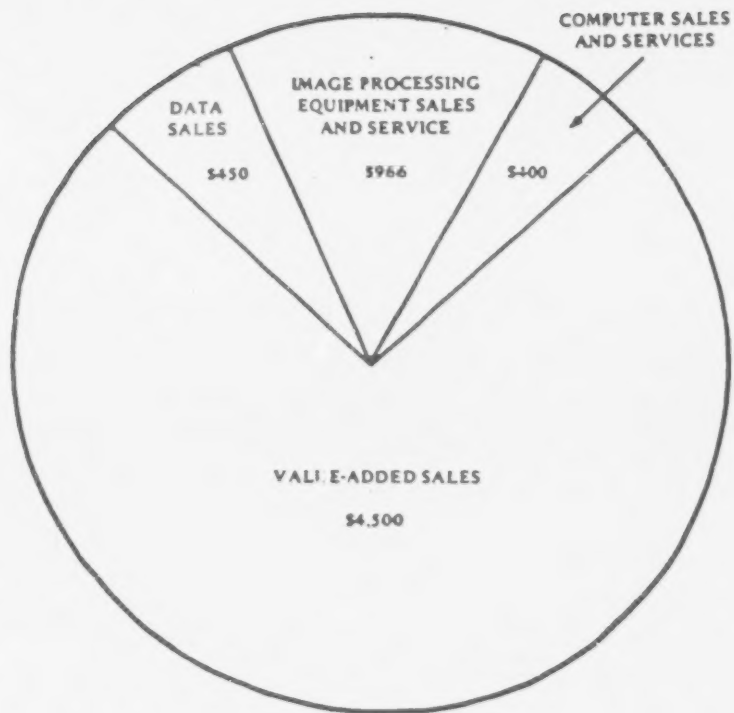


FIGURE 2:

PROJECTED REMOTE SENSING MARKET POTENTIAL AND REALIZABLE REVENUES



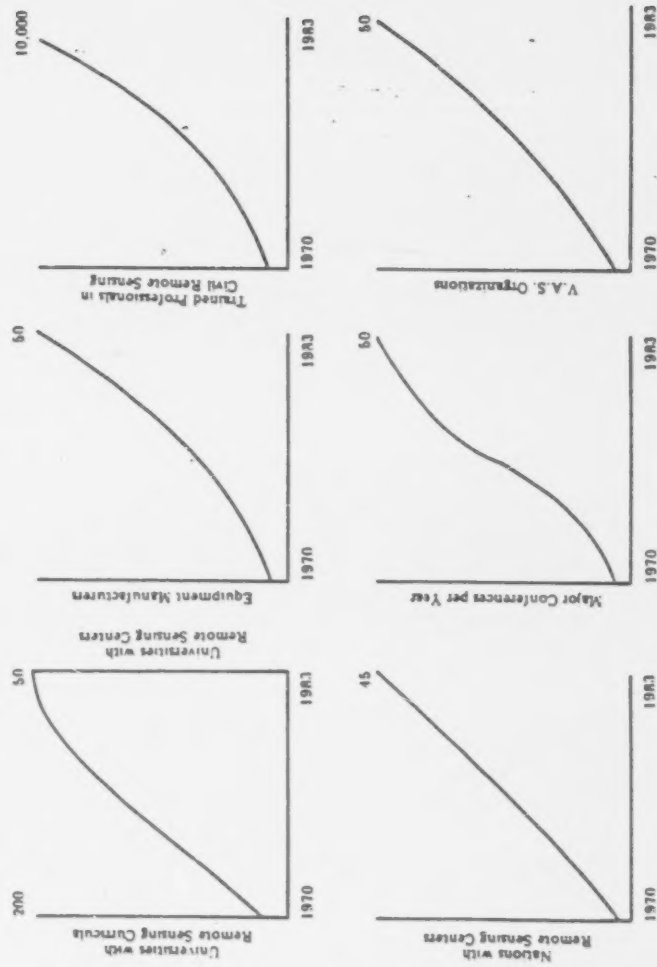
(9/F-)

FIGURE 3:

GROSS INCOME GENERATED BY LANDSAT
(10 year time period)
(\$ millions)

FIGURE 4:

KEY COMPONENTS REQUIRED FOR LANDSAT COMMERCIALIZATION - TRENDS

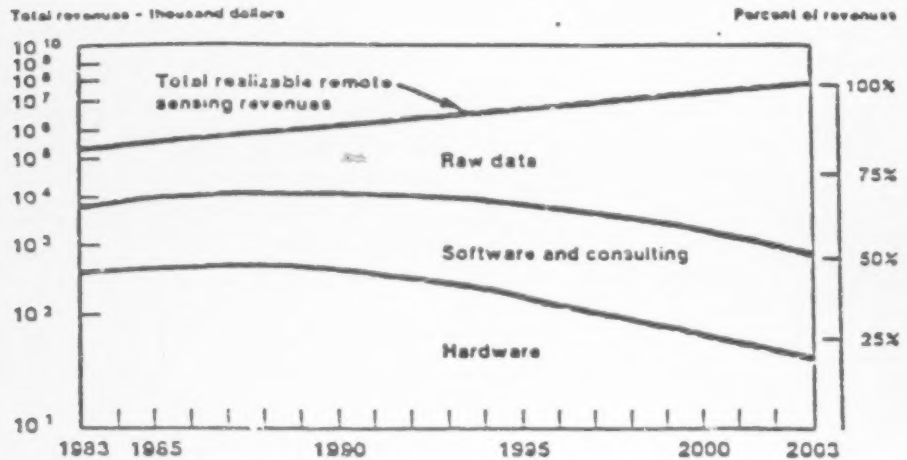


(ERIA Data from Don Lowe, 2/84)

01/791

FIGURE 5:

PROPORTIONAL DISTRIBUTION OF REMOTE SENSING HARDWARE, SOFTWARE, AND DATA REVENUES OVER TIME



(7/64)

SENSOR SPECTRAL CAPABILITY PROVIDES PATH FOR MARKET GROWTH



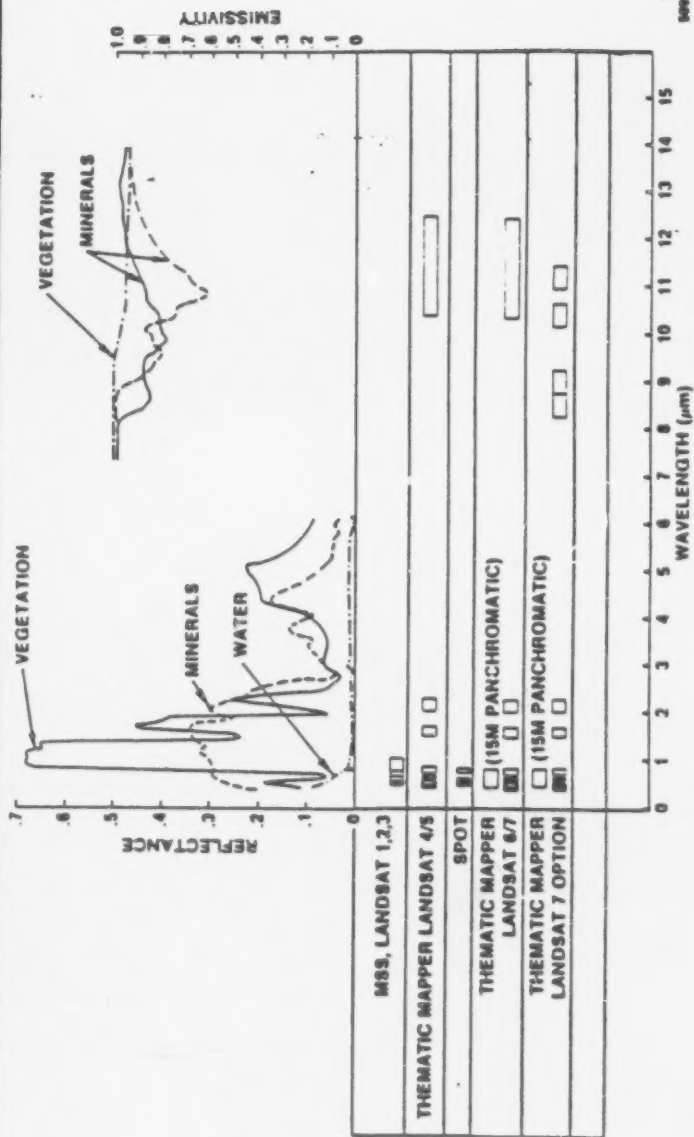
SANTA BARBARA RESEARCH CENTER
a subsidiary

- SPECTRAL SIGNATURES ARE THE KEY TO DATA APPLICATION
- NEW SPECTRAL BANDS YIELD NEW INFORMATION EVEN FOR "UNCHANGING" SCENES
- TWO KEY IMPROVEMENTS
 - SPECTRAL COVERAGE: DATA FROM NEW SPECTRAL REGIONS
 - SPECTRAL RESOLUTION: NEW SPECTRAL DETAILS WITHIN A REGION
- FRENCH SPOT SYSTEM PRESENTS A REGRESSION IN SPECTRAL CAPABILITY
- TM SPECTRAL IMPROVEMENTS ARE BEGINNING TO EXPAND MARKET ALREADY

EVOLUTION OF LANDSAT'S SPECTRAL CAPABILITY

HUGHES

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4/85
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GOVERNMENT/EOSAT
PROPOSED BUSINESS ARRANGEMENT

- o TEN YEAR PROGRAM -
- o FIXED PRICE HARDWARE - ASSURED DELIVERY OF TWO SPACE CRAFT AND ONE IMPROVED GROUND STATION
- o EOSAT FUNDS MARKETING AND OPERATIONS - NO GOVERNMENT SUBSIDY
- o IF CUM REVENUES BELOW 60%

THEN

- A) EOSAT CEASES MARKETING AND TURNS OPERATIONS OVER TO GOVERNMENT
- B). GOVERNMENT CONTINUES OPERATION WITHIN EXISTING REVENUES-NO NEW BUDGET - OR, IF REVENUES NOT SUFFICIENT, COMPLETELY SHUTSDOWN OPERATIONS

COMMERCIALIZATION, AS PROPOSED BY EOSAT.



0 PER OMB: CURRENT BASELINE (L4/5) PROGRAM PRICE IS:

-	\$300 M PER SPACECRAFT, INCLUDING LAUNCH	
-	\$40 M/YEAR OPERATING COST FOR 6 YEARS	
	REQ'D BY P/L98-365	
		- \$600 M (FOR 2)
		- \$240 M
	TOTAL	- \$840 M

COMMENTS:

A. THIS IS THE PROGRAM THE CARTER ADMIN. WAS FOLLOWING.
STOPPED IN 1981.

B. NO PROVISIONS FOR GROUND STATION UPGRADES FOR DATA
VOLUME, NEW PRODUCTS.

C. NO NEW DATA PRODUCTS

D. 3 YEAR SPACECRAFT LIFE.

0 PER EOSAT CONTRACT OFFER TO DOC:

-	\$250 M FOR TWO SPACECRAFT PLUS \$36 M GROUND STATION UPGRADE	- \$250 M
-	\$36 M LAUNCH COST ASSUMED (TITAN II BASELINE)	- \$ 36 M
-	\$0/YEAR OPERATIONS COST FOR 6 YEARS	- \$ 0 M
	TOTAL	- \$286 M

COMMERCIALIZATION, AS PROPOSED BY EOSAT,



PER EOSAT CONTRACT OFFER TO DOC (CONTINUED)

COMMENTS:

A. PROPOSED SYSTEM HAS 5 YEAR LIFE, ADDS 15 METER RESOLUTION BAND.

B. EOSAT HARDWARE CONTRACT IS FIXED PRICE:
NO OPT-OUT EXISTS.

C. OPERATING COSTS UNDER THE EOSAT PROPOSAL ARE PAID BY MARKET REVENUES: SHORT TERM CASH FLOWS ARE BACKED BY HUGHES/RCA. THE 60% REVENUE FLOOR HAS BEEN CHOSEN! SUCH THAT:

- FOR THE PERIOD 1985 - 1989, EVEN THE OMB "GUESS" AT REVENUE DOES NOT PREDICT AN UPSET.
- FOR THE ENTIRE 10 YEARS, GOVERNMENT RISK OF RENEGOTIATION/TERMINATION IS LESS THAN 1% BASED ON REVENUE CONSIDERATIONS.